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(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्)
जम्मू 180001

REGIONAL RESEARCH LABORATORY
COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH
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REGIONAL RESEARCH LABORATORY

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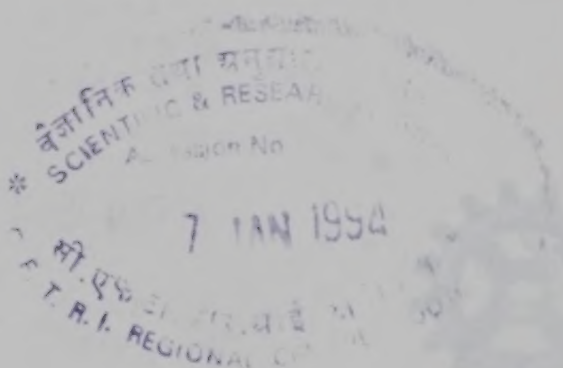

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प्रस्तावना

जैसा कि गत वर्ष उल्लेख किया गया था कि वियतनाम सरकार के लिए प्राकृतिक रंग और रंजक निर्माण हेतु हमारे वर्कशाप में एक संयंत्र निर्माणाधीन था । इस वर्ष इस संयंत्र को वियतनाम के हो-चि-मिन्ह शहर में हमारे वैज्ञानिकों और प्रौद्योगिकीविदों ने सफलतापूर्वक लगा दिया है । इस संयंत्र की लागत का वहन यू एन आई डी ओ द्वारा तथा इसका निष्पादन एन आर डी सी के माध्यम से हुआ। यू एन डी पी ने विभिन्न प्रकार के सुगंधित रसायन (*जिरिनिआल, सिट्रोनेला और टर्पिनिओल*) के निर्माण हेतु एक बहुउद्देशीय संयंत्र का डिजाइन बनाने तथा इसका निर्माण करके वियतनाम में प्रतिस्थापित करने के लिए भी इस प्रयोगशाला को कायम रखा है । हमारे वर्कशाप में इस संयंत्र का निर्माण कर लिया है और इसको प्रतिस्थापन हेतु वियतनाम में भेजने की प्रतीक्षा है। ये दोनों टर्न-की कार्य कठोर प्रतिस्पर्धा के होते हुये भी हमारी प्रयोगशाला को सौंपे गये थे।

मुख्य प्रयोगशाला जम्मू, इसकी शाखा श्रीनगर तथा विस्तार केन्द्र पालमपुर की गतिविधयां जोकि मौलिक, उपयोगात्मक एवं विकासात्मक व विस्तार कार्य का सर्वोत्तम सम्मिश्रण है, इनकी बहुमुखी अनुसंधान एवं विकास गतिविधियां दो शीर्षों के अधीन हैं। अर्थात् वे (i) हमारी अनुसंधान परिषद् द्वारा प्रायोजित परियोजनायें तथा (ii) अन्य अनुसंधान एवं विकास परियोजनायें, में विलेखित की गयी हैं। विभिन्न सफल गतिविधियों और प्रगति का विवरण उचित मदों के अंतर्गत दिया गया है। लेकिन कुछ मुख्य गतिविधियों का संक्षिप्त वर्णन नीचे दिया जा रहा है।

आर्थिक पौधे

नींबू घास की एक नई उन्नत किस्म सी के पी — 25 का अनेक स्थानों पर परीक्षण करने के पश्चात् दिसम्बर 1, 1991 को क्षेत्रीय अनुसंधान प्रयोगशाला, जम्मू के स्थापना दिवस पर औपचारिक रूप से जारी की गई। इस अवसर पर मुख्य अतिथि ने एक पुस्तिका का विमोचन किया जिसमें हमारी प्रयोगशाला द्वारा विकसित इस किस्म की समूची कृषि प्रौद्योगिकी समाहित है।

ओसिमम कैनम की एक विभेद जिसके तेल में अधिक मात्रा में लिनेलूल समाहित होता है, विकसित की गयी है। तेल का उत्पादन 230 किग्रा. प्रति फसल प्रति वर्ष (4% एम एफ बी) है जिसमें 80-85 % लिनेलूल तथा लिनलिल एसीटेट (ऐसीटिक अम्ल का लवण) होता

है। व्यापारिक खेती के लिए इस विभेद को औपचारिक तौर पर जारी करने से पहले इसकी कृषि प्रौद्योगिकी का अध्ययन किया जा रहा है।

जम्मू कश्मीर व हिमाचल प्रदेश में विभिन्न हॉप किस्मों के लिये अन्य क्षेत्र निश्चित करके उनकी जांच की जा रही है। प्रारम्भिक परिणाम उत्साहवर्धक पाये गये हैं। अगस्त 1991 में इन पादपों की खेती तथा कटाई के पश्चात् संसाधन के लिए कीलॉंग, लाहुल और स्पीती में एक सप्ताह का प्रशिक्षण कोर्स आयोजित किया गया। अन्य क्षेत्रों में हॉप की खेती को बढ़ाने के लिये इस कार्यक्रम के अंतर्गत चार गांवों में खेत-प्रदर्शन किये गये।

प्रारम्भिक परिणामों से पता चलता है कि जैमरोजा के दो सिट्रल अल्पमात्रीय म्यूटेंट जोकि प्रयोगशाला द्वारा विकसित किये गये हैं पैत्रिक क्लोन से कृषि मूल्यांकन में समान हैं। जैमरोजा के तेल में सिट्रल अवांछनीय संघटक होते हैं।

औषधि विकास

रिफैम्पिसिनयुक्त विरचनों (AT-1 और AT-2) तथा जैव उपलब्धता को बढ़ाने वाले यौगिक आर एल जे – एन ई –210 वाले डौजियर को दवा के रूप में इस्तेमाल करने से पहले चूहों में 6 माह तक चिरकालीन विषाक्तता के अध्ययन का कार्य पूरा किया गया । परन्तु वैज्ञानिक, जैवरासायनिक और विकृतिजन्य रोगों के बारे में किये गये अध्ययनों में इसका कोई खास पार्श्व प्रभाव नहीं मिला। इन विरचनों का चूहों और घूसों पर पुरुष वंध्यता और थायरोजेनिक प्रभाव देखने के लिए भी अध्ययन किये गये। यौगिक आर एल जे – एन ई –210 के प्रभाव से बढ़ते हुये अवशोषण की क्रिया को जानने के लिये अनेक अध्ययन किये गये।

चूंकि पूरक शोथ बहुत बड़े मध्यस्थों में एक है इसलिए वासवेलिक एसिड्स (वी ए) का पूरकरोधी और शोथरोधी क्रियाओं के मध्य तथा चूहों में सहप्रेरित आथ्राइटिस और कैरीजनन प्रेरित पांव शोथ के प्रायोगिक माडलों में सह संवंध देखा गया है। वासवेलिक एसिड्स (बी ए) से परीक्षण माडलों में शोथ के साथ-साथ पूरक क्रिया में भी प्रचुर मात्रा में कमी आई। बासवेलिक एसिड्स (बी ए) के बारे में दीर्घकालिक विषाक्तता पर अध्ययन पूरा कर लिया गया है और विभिन्न रुधिर संबंधी तथा जैवरसायन परिमापी ज्ञात कर लिये गये जिनसे पता लगा कि बासवेलिक एसिड्स बहुत अधिक औषधि मात्रा और लम्बे उपचार में भी सुरक्षित हैं।

जैव प्रौद्योगिकी

"बायो-रिएक्टर डिजाइन एण्ड प्रेशर फर्मेन्टेशन" पर एक समन्वित प्रायोजना हमारी प्रयोगशाला और टी सी बी विश्वविद्यालय, डॉर्टमण्ड (जर्मनी) के मध्य कार्याधीन है। स्यूडोमोनास, ग्लूकोनोबैक्टर और मैथिलोमोनास नामक जातियों पर जर्मनी में किये गये अध्ययनों से पता चलता है कि इन बैक्टीरियाओं की बढ़वार पर अधिक आक्सीजन आंशिक दबाव का नकारात्मक प्रभाव रहा है। तो भी क्षेत्रीय अनुसंधान प्रयोगशाला, जम्मू में किये गये पूर्ववर्ती अध्ययनों में जैव अम्ल उत्पादन पर उच्च घुली हुई आक्सीजन घोल का सकारात्मक प्रभाव स्पष्ट रूप से पाया गया था। इसीलिये स्थैतिक तथा सक्रिय अवस्था में चुनी हुई जीवाण्विक तथा कवकीय जातियों पर आक्सीजन आंशिक दाब और घुली हुई आक्सीजन के घोल के प्रभाव पर एक मिले जुले अध्ययन की योजना बनायी गयी थी।

प्रक्रिया-विकास

पौधा (कोड नं. 031) से प्राकृतिक रंजक कुसुम्भ पीला तथा कुसुंभी रंग बिलगाने के लिए एक प्रक्रिया विकसित की गयी है। *पौडोफाइलियम एमोडी* से *पौडोफइलोटाक्सिन* का निष्कर्षण पाइलट प्लांट स्तर पर आशाप्रद रहा है और इस संबंध में एक तकनीकी रिपोर्ट तैयार की गयी है।

कटाई बाद की प्रौद्योगिकी

यांत्रिक कटाई तथा कटाई के पश्चात् देखभाल, भण्डारण और केसर की पुलिन की आयु में सुधार के लिए प्रौद्योगिकी का विकास किया गया है। उन कारणों का भी अध्ययन किया गया है जिनसे केसर के गुण प्रभावित होते हैं। जंगली अनार दाने, जिनको सुखाने पर व्यापारिक महत्व का अनार दाना मिलता है, पर भी इसी प्रकार के अध्ययन किये गये हैं। इसके अतिरिक्त अनार दाने के कुछ ऐसे भी उत्पाद तैयार किये गये हैं जिन्हें तुरन्त प्रयोग में लाया जा सकता है। मधुमेह रोगियों के लिये उपयुक्त कितने ही ऐसे फल उत्पाद तैयार किये गये हैं जिनमें चीनी के बदले अन्य योजक मिलाये गये हैं। जो प्रौद्योगिकियां विकसित की गयी हैं वे व्यापारीकरण की प्रतीक्षा में हैं।

प्रशिक्षण और प्रदर्शन

हॉप की खेती, मशरूम की खेती, खरगोश - पालन, एक्वाकल्चर, जल के गुणों का मूल्यांकन तथा चाक निर्माण पर इस वर्ष के दौरान छः कम अवधि के प्रशिक्षण कोर्स आयोजित किये गये।

इस प्रयोगशाला ने केन्द्रीय मसाला अनुसंधान केंद्र द्वारा नई दिल्ली में आयोजित एक प्रदर्शनी में भाग लिया।

पुरस्कार

इस वर्ष जम्मू काश्मीर राज्य की विज्ञान और प्रौद्योगिकी परिषद् द्वारा स्थापित 'युवा वैज्ञानिक पुरस्कार' हमारी क्षेत्रीय अनुसंधान प्रयोगशाला जम्मू के दो युवा वैज्ञानिकों को प्रदान किया गया।

पी.एच. डी. के छात्रों को पर्यवेक्षित करने के लिए, जम्मू विश्वविद्यालय ने इस प्रयोगशाला के दो वैज्ञानिकों को गाइड के रूप में मान्यता प्रदान की है। विभिन्न विश्वविद्यालयों ने छः वैज्ञानिकों को पी.एच. डी. की उपाधि प्रदान की।

प्रकाशन

क्षेत्रीय अनुसंधान प्रयोगशाला, जम्मू के एस. के. कपूर व ए. के. शाही द्वारा लिखित पुस्तक 'प्रानेस आफ नार्थ वेस्ट इण्डिया' एक निजी प्रकाशक द्वारा प्रकाशित की गयी है। क्षेत्रीय अनुसंधान प्रयोगशाला, जम्मू ने एक मोनोग्राफ "ऐग्रोफॉरेस्ट्री कल्टीवेशन" और तीन तकनीकी फोल्डर्स -- कल्टीवेशन आफ हॉप्स, लेमन ग्रास तथा जैमरोजा नाम से प्रकाशित किये हैं। इनके अतिरिक्त हमारे वैज्ञानिकों के अनेक अनुसंधान-पत्र व तीन समीक्षात्मक लेख वैज्ञानिक पत्रिकाओं में प्रकाशित हुये हैं। एक तकनीकी रिपोर्ट जम्मू और काश्मीर राज्य सरकार को समर्पित की गयी है।

अन्य गतिविधियां

हमारी प्रयोगशाला ने 21-23 अक्तूबर 1991 तक जम्मू में "न्यूअर ट्रेन्ड्स इन एशेन्शियल आयल्स एण्ड फ्लेवर" (तेल गंध व महक की ओर नई प्रवृत्ति) पर एक अंतर्राष्ट्रीय परिसंवाद का आयोजन किया। यह परिसंवाद भारत के तेल गंध संघ और भारत की सुगंध एवं महक संघ द्वारा प्रयोजित था। इस परिसंवाद में प्लेनरी व्याख्यान विशिष्ट व्याख्यान और प्रचार-पत्र सम्मिलित थे। इनके अतिरिक्त इस वर्ष के दौरान हमारी प्रयोगशाला ने वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद् तथा क्षेत्रीय अनुसंधान प्रयोगशाला, जम्मू का स्थापना दिवस तथा राष्ट्रीय एकता सप्ताह भी आयोजित किया था। इस प्रयोगशाला के निदेशक और कर्मचारी वर्ग अनुसंधान परिषद् के सदस्यों और प्रबन्ध परिषद् को, अनुसंधान और विकास कार्यक्रम के आयोजन में महत्वपूर्ण नेतृत्व और प्रोत्साहन देने के लिए आभार प्रकट करते हैं।

INTRODUCTION

As reported last year a plant for the manufacture of natural dyes and pigments was under fabrication in our workshop for Govt. of Vietnam. The plant was successfully commissioned during the year at Ho Chi Minh City (Vietnam) by our scientists and technologists. This UNIDO funded project was executed on behalf of NRDC. This Laboratory has also been retained by UNDP to design and fabricate a multi-purpose plant for the manufacture of various aroma chemicals (geraniol, citronellol and terpeniol) and to install it in Vietnam. The plant has been fabricated in our workshop and is awaiting dispatch and installation. Both these turn-key jobs were awarded to our Laboratory under stiff competition.

The multidisciplinary R&D activities of the main Laboratory at Jammu, its Branch at Srinagar and Extension Centre at Palampur which are optimum blend of fundamental, applied, developmental and extension work are presented under two heads, namely (i) projects approved by our Research Council, and (ii) other R&D projects/investigations. These are followed by 'Infrastructure' and 'Appendices'.While the details of various activities and progress achieved are mentioned under appropriate heads, but some salient activities are mentioned briefly hereunder.

Economic Plants

After conducting multi-location trials CKP-25, a new improved variety of lemongrass was formally released on RRL, Jammu Foundation Day organised on 1 December 1991. On this occasion the Chief Guest also released a booklet which contains the complete agrotechnology of this variety developed by our Laboratory.

A strain of *Ocimum canum* has been developed, which contains linalool rich oil.The yield of oil is 230 kg/ha/year (4% MFB) having 80-85% linalool and linalyl acetate. The agrotechnology of this strain is being worked out before its formal release for commercial cultivation.

Alternate areas in J&K and H.P. have been located and trials of different hop varieties are being conducted. Preliminary results are encouraging. One week training course on cultivation and post-harvest processing of hops was organised at Keylong, Lahaul and Spiti in August 1991. Field demonstrations

were held in four villages as part of the programme to extend cultivation of hops in other areas

Preliminary results show that the two citral deficient mutant clones of Jamrosa developed by the Laboratory on comparative agronomic evaluation were found to be at par with the parent clone. In oil of Jamrosa citral is undesirable constituent.

Drug Development

As a prelude to compilation of preclinical dossier of formulations (AT-1 and AT-2) containing rifampicin and bioavailability enhancer compound RLJ-NE-210, six month chronic toxicity studies in rats were completed. Haematological, biochemical and histopathological studies have not revealed any significant side effects. Studies were also conducted to see the effect of these formulations on male sterility and thyrogenic effect in mice and rats. A number of studies were conducted to pinpoint the probable mechanism of increased absorption under the influence of compound RLJ NE-210.

Since complement is one of the major mediators of inflammation, so the correlation between anticomplementary and antiinflammatory activities of boswellic acids (BA) was observed in experimental models of adjuvant induced arthritis and carrageenan induced paw oedema in rats. BA reduced significantly inflammation as well as complement activity in test models. Chronic toxicity studies on BA have been completed and various haematological and biochemical parameters were determined, which revealed that boswellic acids are safe even in very high doses and on prolonged treatment.

Biotechnology

A co-ordinated project on "Bio-reactor Design and Pressure Fermentation" between our Laboratory and TCB, University of Dortmund (Germany) is under execution.Studies conducted in Germany on *Pseudomonas*, *Gluconobacter* and *Methylomonas* species have revealed negative influence of high oxygen partial pressure on growth of these bacteria. However, distinctly positive influence of high dissolved oxygen concentrations on organic acid production was found in earlier studies conducted at RRL,Jammu. Thus a coordinated study on the influence of oxygen partial pressure and dissolved oxygen concentration in static and dynamic states on selected bacterial and fungal species was therefore planned

Process Development

A process has been developed for isolation of natural pigments, safflower yellow and carthamine from plant (Code No.031). A process for the extraction

of podophylotoxin from *Podophyllum emodi* has been optimised at pilot plant level and technical report has been prepared.

Post-harvest Technology

Technology has been developed for mechanical harvesting, post-harvest handling, storage and improvement of shelf-life of saffron. Factors affecting the quality of saffron have also been studied. Similar studies have been conducted in wild pomegranate seeds which on drying yield *Anardana* of commerce. In addition to that some ready - to - use products of Anardaea have also been prepared. A number of fruit products have been prepared where sugar has been replaced with other additives to make them suitable for diabetics. The technologies developed are awaiting commercialisation.

Training and Demonstration

Six short term training courses were organised during the year on hops cultivation, mushroom cultivation, rabbit farming, aquaculture, water quality assessment and chalk making.

The Laboratory participated in an exhibition organised by Central Social Welfare Board at New Delhi.

Awards

Two young scientists of RRL,Jammu were given Young Scientist Award instituted during the year by J&K State Council of Science and Technology.

Two scientists of the Laboratory have been recognised as guide to supervise Ph.D. scholars by the University of Jammu. Six scientists have been awarded degrees of Ph.D. by various universities.

Publications

One book entitled "*Grasses of North West India*" by S.K.Kapur and A.K.Shahi of RRL, Jammu has been published by a private publisher. A monograph entitled "*Asparagus cultivation*" and three technical folders on *Cultivation of hops, lemongrass* and *Jamrosa* have been published by RRL, Jammu. Besides number of research papers, three review articles have been published in scientific journals by our scientists. One technical report has been submitted to J&K state government.

Other Activities

An International Symposium on "Newer Trends in Essential Oils and Flavours" was organised by our Laboratory from 21-23 October 1991 at Jammu. The symposium was co-sponsored by Essential Oil Association of India and Perfumes & Flavours Association of India. The symposium con-

sisted of plenary lectures, special lectures and poster sessions. Besides this Foundation Days of CSIR and RRL, Jammu and National Unity Week were also organised during the year by our Laboratory.

The Director and staff of the Laboratory thank the Members of the Research Council and Management Council for valuable guidance and support given by them in planning and execution of the R&D programmes.

R&D PROJECTS APPROVED BY RESEARCH COUNCIL

01 DRUGS AND PHARMACEUTICALS

01 RC 01 Hepatoprotective Drugs

(a) RRL-NE-451 (043)

This fraction from the plant No.043 showed maximum hepatoprotective activity. The effect was further confirmed by multi dose treatment with 200 mg/kg p.o. given at –48 h, –24 h, –2 h and +6 h of CCl_4- intoxication in mice. CCl_4 alone caused a significant increase in SGPT activity, hepatic triglycerides and microsomal lipid peroxidation as compared to control animals. Pretreatment with RLJ-NE-451 (043) brought down significantly, the CCl_4-induced increase in these parameters. In this study there was no significant change in, hepatic ALP, ACP, protein, liver and body weight. Chemically the active fraction showed positive test for acid and indication for phenolic hydroxy group by UV. This fraction was further fractionated into three fractions, *viz.* ethyl acetate RLJ-NE-451 (043-1); n- butanol RLJ-NE-451 (043-2) and total residue RLJ-NE-451 (043-3), respectively. When tested biologically for hepatoprotective activity RLJ-NE-451 (043-1) showed maximum activity. Efforts were made to isolate pure compounds responsible for hepatoprotective activity from this active fraction. RLJ-NE-451 (043-1) was subjected to Medium Pressure Liquid Chromatography (MPLC) using chloroform and ethyl acetate as solvent in different ratios. In all thirty fractions were collected and finally the column was washed with pure methanol. These fractions were pooled in three parts RLJ-NE-451 (043-1d to 1f). The methanol washing which was about 70% pure yielded RLJ-NE-451 (043-1g). All these fractions were biologically evaluated for their hepatoprotective activity and RLJ-NE-451(043-1e) showed maximum effect. Fraction RLJ-NE-451 (043-1e) was crystallized to get pale yellow material in 0.23% yield on dried fruit basis, m.p. 248-249^{o}C, highly soluble in acetone, lukewarm water and methanol which gave strong positive test for phenolic hydroxy group. UV of the compound in methanol and its shifts were observed with different reagents.

Acute LD_{50} of compound RLJ NE 451 (043-1e) and its effect on general behaviour in mice in doses upto 2.0 g/kg p.o. and i.p. did not show any change in the behaviour and there was no mortality upto 72 h period under observation.

(b) RLJ-NE-144 (069)

It showed very potent hepatoprotective activity both as prophylactic as well as curative against CCl_4 - induced hepatotoxicity in doses 250 and 500 mg/kg p.o. With multidose treatment in mice *(in vivo)* at sub-cellular level, it counteracted CCl_4– induced hepatic microsomal lipid peroxidation. Microsomes obtained from the liver of animals treated with RLJ-NE-144(069) and CCl_4 showed that the test drug significantly counteracted CCl_4 - induced inhibition in the activities of drug metabolising enzymes, namely amidopyrine N-demethylase and aniline hydroxylase. The effect on hepatic mitochondrial ATPase was not significant whereas the effect on microsomal lipid peroxidation was highly significant. To isolate active principle(s), RLJ-NE-144(069) was fractionated by various methods like passing through filters (amicon cut off) to obtain three fractions of different m.w., different solvent extraction and precipitation by ethanol. Although some fractions obtained by above method showed hepatoprotective activity, but none of these exhibited biological activity more than the RLJ-NE-144(069), the parent fraction.

(c) Hepatoprotective standard

In continuation of work for establishing a standard for hepatoprotective testing, effect of silybin was also studied in graded doses 12.5, 25.0, 50.0 and 100.0 mg/kg given as single dose and also in multidose treatment. The parameters studied were hexobarbitone sleep and zoxazolamine paralysis in mice with single dose and SGPT, SGOT, BSP clearance and total proteins in rats with multidose treatment. In all the parameters studied, silybin showed significant dose related hepatoprotective effect both with single as well as multidose treatment. However, when comparing with silymarin, it has been observed that the latter has definite better effect. Silymarin and silybin were tested alone and also in combination with different ratios in doses of 25.0 mg, 50.0mg and 100.0 mg/kg p.o. on different parameters. Hepatoprotective activity has been observed in animals with silymarin and silybin alone as well as in all the different combinations. On comparison, silymarin showed the maximum activity.

01 RC 02 Anti-inflammatory Drugs

(a) Boswellia serrata gum resin

CHEMISTRY

(i) The method for the isolation of major active principles of the said gum optimized.

(ii) The yields upto 34% of active mixture were obtained depending upon the quality of the material and time of collection.

(iii) About 25 kg of active mixture was prepared for the clinical trials.

(iv) Larger quantities of four major active principles were also prepared separately and purified.

(v) Structure modification of major components was carried out.

(vi) In total about thirty analogues were prepared and subjected to various biological activities.

(vii) The extraction and fractionation of the gum procured from other regions was also carried out.

(viii) The fractions and analogues prepared include RLJ-NE-422, RLJ-NE-446 to 449, RLJ-SS-502 A_1 to RLJ-SS-502-A_{22}.

(ix) These analogues displayed varying degree of activities.Based upon these studies a relationship between their structures and activity (SAR) would be established.

(x) Besides the major components four minor compounds were also separated by column chromatography.

(xi) Two of the minor compounds have been assigned the structure based upon chemical transformation and spectral studies. Their structures are 3α,24-dihydroxy-urs-12-ene and 2α, 3α-dihydroxy-urs-12-ene 23-oic acid.

PHARMACOLOGY (CHRONIC TOXICITY)

(i) Daily oral administration of boswellic acids in three dose levels in rats was completed and various haematological and biochemical parameters were determined in control and drug treated rats as reported in the last year's report. Histopathology of various vital organs obtained from these rats revealed no change in architecture of different tissue cells, indicating the safety of boswellic acids even in very high doses on prolonged treatment.

(ii) Study on the chemically standardised mixtures of the boswellic acids was carried out in acute test of carrageenan induced oedema and chronic adjuvant arthritis in groups of 5 rats. Their anti-inflammatory activity (AIA) is recorded in Table 1.

Table 1: Anti-inflammatory Activity (AIA) of Chemically Standardised Mixtures of Boswellic Acids

Compounds (Code No.)	AIA at 100 mg/kg p.o.	
	Carrageenan oedema	Adjuvant arthritis
RRJ-NE-33	—	50.0
RRJ-NE-334	—	44.5
RRJ-NE-335	—	52.2
RRJ-NE-369	—	50.0
RRJ-NE-422	—	41.5
RRJ-NE-446	—	15.4
RRJ-NE-447	20.5	—
RRJ-NE-448	—	—
RRJ-NE-449	22.0	23.0
RRJ-NE-461	—	59.0
RRJ-NE-461A	—	50.0
Ibuprofen	58.0	55.0

AIA = Anti-inflammatory activity
Each group comprises of 5 rats

(b) Other studies

(i) Thirty-eight compounds of P-series synthetically developed were obtained from the Organic Chemistry Department of Kurukshetra University, Kurukshetra (Haryana) and subjected to AIA testing by carrageenan induced oedema in groups of 5 rats at a dose of 100 mg/kg p.o. Out of these series compounds Nos. P-210 and P-188 demonstrated 64% and 61% AIA respectively.

(ii) Forty-two compounds of SS series synthetically prepared by the University of Jammu were subjected to anti-inflammatory screen at a dose of 100 mg/kg p.o. in groups of 5 rats. Compounds SS-1 and SS-176 displayed 52% and 46% AIA respectively.

01 RC 03 Immunomodulating Agents

(a) Plant No. 051

(i) IMMUNORESTORATIVE EFFECT OF RLJ-NE-299A

Fraction RLJ-NE-299A was found to restore enhance the humoral antibody synthesis in animals simultaneously treated with the immunosuppressive agents. Experiments were conducted to determine the effect of prior or postadministration of this fraction on the immunosuppressive effect of immunosuppressive agents.

Intraperitoneal administration of this fraction (6.25, 12.5, 25.0 mg/kg) for 7 days prior to immunization produced a dose related increase (27.0 to 35.13%) in humoral antibody synthesis in rats treated with cyclophosphamide (Cy) (50 mg/kg p.o.) for 3 days post-immunization.

In rats treated with azathioprine (Aza) (50 mg/kg p.o.) for 3 days after immunization, administration of the fraction 299A (6.25, 12.5 & 25 mg/kg i.p.) for seven days prior to immunization was found to significantly enhance the humoral antibody titre at 12.5 and 25 mg/kg dosages.

In an experiment in which cyclophosphamide(Cy) (100 mg/kg) was administered orally for 4 days post -immunization or 250 mg/kg p.o. for 1 day prior to immunization, 8.82 and 20.58% reduction respectively was observed in the humoral antibody titre. Administration of the fraction 299A (6.25, 12.5 and 25 mg/kg i.p.) for 7 days prior to Cy produced a significant increase (26.38-49.67%) in the humoral antibody synthesis in animals treated with 100 mg/kg Cy and 62.96% in animals treated with a single dose of 250 mg/kg Cy.

Oral administration of betamethasone (500 μg/kg), Aza (300 mg/kg), and Cy (300 mg/kg) for two days (day - 1 & 0) produced a significant reduction (40.27, 29.54 and 94.34% respectively) in mice. In such animals administration of fraction 299A for 5 days post-immunization and immune suppression at a dose of 25 mg/kg i.p. was found to produce 42.00, 29.03 and 100.17% increase respectively in humoral antibody synthesis.

In rats treated with Cy (100 and 300 mg/kg) for 5 days post-immunization or betamethasone (500 μg/kg), Cy (250 mg/kg) Aza (250 mg/kg) 60 to 100% mortality was observed within 7 days of treatment. Fraction 299A (6.25-25 mg/kg i.p.) administered concomitantly for 3 days after the initiation of suppressive therapy was not able to protect the animals from the lethal effect of these drugs.

Increased mortality or synergistic effect of fraction 299A observed with immunosuppressive agents suggested a mechanism by which the potentiator may activate cells of the immune system and make them more susceptible to the cytotoxic agent which have greater effect on active cells.

(ii) GENERAL PHARMACOLOGY OF FRACTION NO.RLJ-NE-229A

This fraction displayed no effect on blood pressure and rate and rhythm of heart beat and respiration in anaesthetized dogs and rats in a dose range of 2.5 to 100 mg/kg i.v. and 50 mg/kg i.d. in dogs. Pressor responses to adrenaline and carotid occlusion and depressor responses to Ach., Hist. and 5HT were not influenced at 20 mg/kg i.v. doses of fraction 299A. It showed no cardiac stimulant or depressant activity in isolated heart. No vasodilatory activity was observed in coronary outflow in isolated heart and isolated blood vessels in rat hind quarter preparation. It showed slight bronchoconstriction

followed by bronchodilation in isolated lung preparation experiments. Fraction 299A showed no antispasmodic activity against Hist., Ach. and 5HT in isolated guinea pig ileum and against Hist. and carbachol in guinea pig tracheal chain. Fraction 299A was found to be devoid of CNS stimulant or depressant effects in mice. It displayed mild (30-35%) anti-inflammatory activity against carrageenan induced oedema in rats and no analgesic activity in mice.

Sub-acute toxicity : Oral administration of fraction 299A at 25, 50 and 100 mg/kg doses for 3 weeks showed no adverse effect on body weight, haemoglobin concentration and total leucocyte counts in rats.

(b) Immunomodulatory activity of some plant extracts fractions

Several plant extracts/fractions were examined for their effect on the immune system and the results are presented in Table 2. All the fractions demonstrated stimulation of antibody synthesis in rats except RLX which displayed the immunosuppressive activity.

Table 2 : Effect of Some Plant Fractions/Pure Principles on Humoral Antibody Synthesis

Fraction/Principle	Dose mg/kg	Route	Change in antibody titre (%)	P-value
PKI-PR	12.50	i.p.	51.61	<0.01
PKII-PR	12.50	i.p.	58.06	<0.001
PKIII-PR	12.50	i.p.	48.38	<0.001
RLJ-NE-216	6.25	i.p.	15.38	N.S.
	12.50	i.p.	20.19	<0.01
	25.00	i.p.	41.02	<0.01
RLJ-NE-298	10.00	p.o.	43.18	<0.05
	50.00	p.o.	36.36	<0.05
RLJ-NE-299A	2.50	p.o.	12.00	N.S.
	5.00	p.o.	8.70	N.S.
	10.00	p.o.	31.00	<0.05
RLJ-NE-299B	2.50	p.o.	7.60	N.S.
	5.00	p.o.	24.00	N.S.
	10.00	p.o.	20.00	N.S.
RLJ-NE-374A	10.00	p.o.	36.84	0.02
	50.00	p.o.	48.02	0.001
RLJ-NE-347B	10.00	p.o.	21.05	0.01
	50.00	p.o.	47.02	0.001

(Contd.)

RLJ-NE-347C	10.00	p.o.	23.68	<0.05
	50.00	p.o.	42.10	<0.05
RLJ-NE-370	10.00	p.o.	50.00	<0.001
	50.00	p.o.	68.18	<0.001
OSW-1	500.00	p.o.	— 9.67	N.S.
RLJ-NE-399B	3.12	i.p.	11.84	N.S.
	6.25	i.p.	15.78	N.S.
	12.50	i.p.	57.89	<0.001
RLJ-NE-467A	100.00	p.o.	17.28	<0.05
468B	100.00	p.o.	35.71	<0.01
469C	100.00	p.o.	43.20	<0.01
RLJ-NE-409	6.25	i.p.	8.10	N.S.
	12.50	i.p.	24.32	<0.001
	25.00	i.p.	40.54	<0.001
RLJ-NF-497A	50.00	p.o.	25.71	<0.01
	100.00	p.o.	31.42	<0.001
	200.00	p.o.	54.28	<0.001
RLJ-NF-497B	100.00	p.o.	25.71	<0.01
	200.00	p.o.	48.57	<0.001
RLX	6.25	i.p.	- 3.36	N.S.
	12.50	i.p.	-23.72	<0.01
	25.00	i.p.	-33.89	<0.001
	50.00	i.p.	-37.28	<0.001
	100.00	i.p.	-44.06	<0.001
	200.00	i.p.	-49.15	<0.001
S.C.	3.12	p.o.	29.41	N.S.
	6.25	p.o.	44.11	<0.02
	12.50	p.o.	52.94	<0.01

01 RC 04 Bioavailability Enhancers

(a) Bioavailability enhancer studies

(i) Six months chronic toxicity studies in rats with formulations AT-1 and AT-2 containing bioavailability enhancer compound No. RLJ-NE-210 have been completed. Haematological, biochemical and histopathological studies have not revealed any significant side effects.

(ii) Three months chronic toxicity studies in monkeys have been completed with the formulation AT-1. Physical observations, haematological,

biochemical and histopathological studies have not revealed any significant adverse effects. All the parameters under study were within normal range.

(iii) Pilot study was carried out with formulation AT-3 in normal human volunteers as a prerequisite of Phase I clinical trial to ascertain the minimal effective dose of the bioavailability enhancer (RLJ- NE-210). Different doses (5,10 & 20 mg) of this compound were combined with a fixed dose of rifampicin and administered to human volunteers. Detailed pharmacokinetic studies have revealed (a) RLJ-NE-210 is very effective in increasing the bioavailability of rifampicin in human volunteers, (b) variation in the dose of RLJ-NE-210 does not produce a significant difference in Cmax, although in two out of five volunteers marginal increase in elimination phase was observed at 10 mg dose level.

(iv) *Male fertility studies of the formulations AT-1 & At-2* : As a prelude to compilation of preclinical dossier of these formulations studies were carried out on the effect of highest dose (used in general toxicity studies) on fertility index and weight of primary and secondary sex organs in rats. These studies have revealed no change in the above parameters with 125 mg/kg of AT-1 and 80 mg/kg of AT-2 in the treated rats.

(v) *Thyrogenic effect of RLJ-NE-210 in mice & rats* : No significant change was recorded in both the species on treatment upto 40 mg/kg (p.o.) on daily administration for seven days.

(vi) Stability studies on formulations AT-1 & At-2 under accelerated conditions of temperature, humidity and light have revealed that the bioavailability enhancer RLJ-NE-210 is offering 25% protection over the formulation where this compound was not added.

(vii) Studies on the distribution of the radioactive RLJ-NE-210 in rat were carried out. Results have shown significant time dependent localization of the compound in the absorptive surfaces/intestinal epithelial cells.

(viii) Studies were carried out on hepatoma cells in culture as model for the study of drug interaction. Modulation of cytochromes P450 activities was found similar to *in vivo* studies in rat liver. Further, the structure activity relationship of analogues of RLJ- NE-210 has been investigated in untreated and inducers treated rat liver microsomes. Results have revealed that modification of the methylene dioxy phenyl ring in the side chain influenced the activity of Aryl hydrocarbon hydroxylase and 7 methoxycoumarin demethylase variably.

(b) Mechanism of action

To pinpoint the probable mechanism of increased absorption under the influence of compound RLJ-NE-210 following studies were carried out.

(i) Studies on the influence of RLJ-NE-210 on gamma-glutamyl transpeptidase activity in intestinal epithelial cells have shown an increase in this activity which could be correlated with alteration in cell permeability. A time dependent change in lipid peroxidase activity was also observed with this compound in intestinal epithelial cells which also indicates increased cell permeability.

(ii) Studies on the influence of RLJ-NE-210 p.o. on changes in membrane fluidity of rat intestinal brush border have revealed significant time dependent alteration. The maximum being at 15 min. post dosing. Normal configuration was, however, attained after 15 min.

(iii) *Effect on metabolizing enzymes:*

(a) Long term interaction of RLJ-NE-210 and/or rifampicin with cytochrome P450 monooxygenases has revealed enzyme induction.

(b) Activity of certain partially purified dehydrogenases was observed to be inhibited under the influence of RLJ-NE-210.

(c) Influence of RLJ-NE-210 on site specific substrate stimulated mitochondrial respiration was studied both in energy coupled mitochondria and also in hypotonic treated mitochondria. Mitochondrial respiration was insensitive to RLJ-NE-210 concentration below 50 μM while higher concentrations impaired substrate-stimulated respiration at site 1.

01 RC 05 Studies on the Behaviour of GIT Hormones under the Influence of Drugs Causing GIT Dysfunction

Studies on the effect of compound No. RLJ-NE-014 on enzymic activities in gastric mucosa and gastric fluid have revealed that the extract (100mg/kg p.o.) causes significant enhancement in pepsin activity in gastric mucosa when administered 1 hr prior to histamine. The effect of MMI, a secretagoge, on these enzyme activities was also studied. The results showed that MMI did not affect H, K-ATPase in both gastric mucosa as well as gastric fluid after 2.5 hrs of treatment. On the other hand, pepsin activity showed a significant enhancement in gastric mucosa but not in gastric fluid in rats, treated with MMI and activity remained elevated in MMi + RLJ-NE-014 treated sample. Similar studies were carried out using R1, R2 and R3 fractions of the whole extract. The results obtained after oral administration of R1 and R2 (100mg/kg) were similar to the whole extract, whereas R3 fraction showed a higher level of enhancement in the pepsin activity after MMI treatment. TGI exhibited dose dependent increase in 50 mg/kg in experimental animals with lomophen-induced hypomotility.

01 RC 07 (1) Exploring New Experimental Models

(a) Model for hepatic necrosis

Alcohol and hepatitis viruses are among the commonest agents causing liver cell necrosis. Carbon tetrachloride induced liver necrosis in rats has been viewed as not an ideal model. Galactosamine induced liver injury resembles viral hepatitis but its high cost is a limiting factor. Attempts to produce liver necrosis in rats with alcohol by various workers have failed so far. As per the initial results, we hope to produce hepatic necrosis in rats treated with alcohol and disulfiram under anoxia condition.

(b) Model for anti-inflammatory testing

Subsequent to our earlier work on anti inflammatory testing model against papaya latex induced inflammation in rat hind paw, further work on induction of inflammation with individual constituents of papaya latex *viz.* papain, chymopapain and glutathione and in combination is in progress.

(c) Other related studies

(i) Forty-five synthetic compounds based on pyridopyrimidines and quinazolines were subjected to pharmacological evaluation. These have shown marked anti-allergic, oxytocic and bronchodilatory activities. Cardiac depressant and low therapeutic ratio observed with these compounds are the limiting factors for their development as new drugs. Modification of some of these molecules is being attempted with the hope to reduce their toxic effects.

(ii) Different fractions of Plant No.093 were tested for cardiotonic activity on hypodynamic heart. Active fractions were identified for providing lead to the chemist for isolation of active constituent.

01 RC 07 (2) Use of Isolated Hepatocytes in Hepatotoxicity and Screening of Hepatoprotectives

Freshly isolated hepatocytes in suspension or in culture are the systems of choice currently used for screening of hepatoprotectives. The *in vitro* suspension model with respect to time and ID_{50} values of hepatotoxicants was validated. Cells were isolated by calcium-free collagenase perfusion of rat liver. Medium conditions were standardised and cells were incubated in buffered medium under oxygen for four hrs without losing viability. Paracetamol, D-galactosamine and carbon tetrachloride were used as the hepatotoxicants. Biochemical response to cellular injury was investigated, *e.g.* oxygen uptake, enzymes leakage, GSH, MDA and UDP-glucuronic acid contents and monooxygenase activities. Biochemical changes with respect

to each hepatotoxicant were delineated. Cells offer a simple and rapid system of choice for prescreening antihepatotoxicants.

01 RC 08 Immunoprotection in Leishmaniasis

(a) Antileishmanial activity

Thirteen synthetic pyrido [1,2-*a*] pyrimidine compounds were tested for their antileishmanial activity *in vitro*. Only two compounds *viz* RLJ-SY-203 and RLJ-SY-131 showed significant antileishmanial activity as compared to the standard antileishmanial drug pentamidine.

(b) Anticomplementary activity

Since parasite itself exhibits anticomplementary activity, it was assumed that the role of membrane molecules of parasite and the complement receptors of the macrophages play a vital role in the cell — cell interaction and infection of host's cells. Therefore a study of complement, complement receptors and surface molecules of the parasites is of great relevance. The same two compounds *viz* RLJ-SY-203 and RLJ-SY-131 when tested for complement activity showed no inhibitory effect. Simultaneously pentamidine was also applied for the test.

The parasite alone incubated with guinea pig serum, showed marked anticomplementary activity. But parasite incubated with pentamidine or compounds like RLJ-SY-203 RLJ-SY-131, showed no anticomplementary activity. Thus it indicates that the surface molecules of parasites are bound by these compounds, thus rendering parasites unable for their anticomplementary activity. From these observations it has been predicted that the macrophage parasite interaction and thereafter infection can also be prevented by treating parasites with procomplementary compounds. It is thus assumed that the compounds having procomplementary activity may have antileishmanial effect.

(ii) Five different analogues of β-Boswellic acid(BA) *viz* 3-epipropionoxy-β-BA; trifluroacetoxy-β-BA; 3-epiacetoxy-β- BA; 3-epi-β-BA and trifluoroacetoxy-11-keto- β-BA were tested for anticomplementary activity. 3-epiacetoxy-β-BA showed the highest effect.

(iii) Since complement is one of the major mediators of inflammation, so the correlation between anticomplementary and anti-inflammatory activities of boswellic acids (BA) has been observed in experimental models of adjuvant induced arthritis and carrageenan induced paw oedema in rats. BA reduced significantly inflammation as well as complement activity in test models. This was compared with the standard anti-inflammatory drugs like aspirin and ibuprofen.

(c) Fraction No. RLJ-NE-205 was studied for its anticomplementary activity. A marked inhibitory effect on complement system was observed. This fraction was also found to possess immunoadjuvant activity, and also activated peritoneal macrophages. Five different lots of this fraction were evaluated for their anticomplementary activity and similar results were obtained.

02 NATURAL PRODUCTS (CULTIVATION)

02 RC 01 Screening and Development of Aromatic Plants for Important Essential Oils and Aroma Chemicals

(a) Ocimum carnosum Lk. et. Otto.

Genetic upgradation of *O. carnosum* through induction of colchiploidy and breeding of the selected genotypes for increased yield of herbage and oil and content of elemicin in oil was carried out. The colchiploid plants exhibited luxuriant vegetative growth with large, thick leaves and also increased thickness of the stem. The plants showed substantial increase (upto 1.250 g/plant) in the overall biomass. There was an increase in the essential oil percentage but the elemicin content remained almost the same (60-65%). Further studies showed that during the months of September to October, the oil yield (0.35% FWB) and elemicin content (65%) were the maximum.

Application of Triacontanol (growth regulator) as foliar spray was resumed at 3 concentrations *i.e.* 5, 10 and 15 ppm at interval of 10-15 days during February, 1991 when the crop picked up sufficient growth. After two sprays the second harvest was taken in first week of May. The data obtained (Table 3) shows that plant height, number of leaves and herbage yield per plant as well as total herb yield per treatment increased in treated plants as compared to control.

Table 3 : Effect of Triacontanol on growth Characters and Yield Components in *O. carnosum* During Second Harvest

Treatment	Plant height (cms)	No of Laterals	No of Leaves	No of Inflorescences	Fresh Per Plant (gm)	Herbage yield Per 36^2m (kg)	% increase decrease over control	Oil content (MFB)
C	79.8	11.50	192.5	17.0	320.4	61.0	—	0.48
T1	90.2	9.61	271.2	20.3	420.0	79.1	29.6	0.47
T2	89.2	9.50	271.5	25.2	464.5	83.0	36.0	0.60
T3	89.0	7.60	203.6	17.8	300.0	56.0	—	0.50

C - Control (Plain water)
T1 - 5 ppm Triacontanol
T2 - 10 ppm Triacontanol
T3 - 15 ppm Triacontanol

Number of laterals and inflorescences per plant remained unchanged. Maximum effect was noted at 10 ppm concentration which showed an increase of 36% in total herb yield over control. Oil percentage remained at par with control, but oil yield increased. It was found that total herbage per unit area increased considerably during 2nd harvest in *O. carnosum* and treated crop was superior to control.

(b) Ocimum canum* Sims. *(Methyl cinnamate strain)

Breeding studies for developing *O. canum* as a rich source of methyl cinnamate were carried out. The second phase of screening and chromatographic evaluation of the segregating population raised of the previously selected genotypes showed improvement in oil yield (0.50 to 0.55%) and methyl cinnamate percentage in oil (70-80%). The seed collected of both selfed and controlled selectants would be used for further improvement studies.

***(c) Ocimum adscendens* Willd.**

First and second phases of screening and evaluation of *O. adscendens* population raised from intraspecific hybrids and other selected genotypes showed low genotypic variation in the yield characteristics. It was found that flowering shoots at mid-flowering stage yielded better essential oil content (upto 0.7%). The individual plant analysis for essential oil still exhibited lower range of farnesol (20-30%). Efforts are on to induce greater variability for selection while raising the level of population to widen the spectrum of screening.

(d) Clocimum 3C

A heterotic hybrid having high essential oil yield (Av. 1.2% on whole herb basis) and increased content of eugenol and its derivatives (upto 90% on GC and ^{1}NMR evaluation) has been developed and subjected to comparative performance trial in the areas under typical tropical climates of Kerala and Tamil Nadu extending to Maharashtra and sub-tropical regions of North India. The yield performance trial of the new strain is being carried out at Field Research Station, Chatha in comparison to the old Clocimum strain.

(e) Ocimum canum Sims. (rich in Linalool)

As a result of specialized hybridizational programme among the selected genotypes, the present strain of *O. canum* (RRL-Oc-11) having average herbage yield of 600 gm/plant and average oil yield of 4% (MFB) with 80-85% linalool + linalyl acetate has been evolved. This strain has found acceptance with the essential oil industry as an alternate source of linalool. This crop cultivated in an area of 0.05 hectares at Chatha Farm has confirmed the earlier yield reports (yield of oil 230 kg/ha/year).

(f) Cymbopogon flexuosus (Nees ex Steud.) Wats

Mass screening of *Cymbopogon* strains led to the discovery of α-bisabolol rich strain of *C. flexuosus* (coded G.P. 100). Optimization study of yield parameters as well as further improvement of the strain through breeding was carried out. The oil percentage varied from 0.16-0.26% on fresh weight basis while α-bisabolol content ranged from 20-25% in the oil.

02 RC 02 Agrotechnology and Improvement of Economic Plants

02 RC 02 (1) *Salix* Species

(a) Multiplication of exotic Salix Species

Out of fifteen exotic *Salix* species seven species which are in small numbers have been multiplied in RRL Science Garden. Cuttings of other species worth Rs.54,000/- were supplied to J&K Social Forestry Project, National Institute on Yalk (Dirong, Arunachal Pradesh) and Association for Welfare and Rural Education, Jammu, for the economic afforestation of hilly terrains. Three quintal shoots of *Salix cinerea*, wicker species, were sent to Srinagar for preparing the various wicker items for testing and demonstration.

(b) Other related activities

(i) One thousand plants of *Telosma pallida* (Gwalmonda), a forest vegetable of 'Kandi' areas of Jammu Province, were raised from cuttings and supplied to Eco-Task Force, Jammu, for plantation in the Jammu region.

(ii) Following species have been planted as new addition to the Science Garden (Germplasm Centre) :

Salix coerulea

Murraya koenigii

Populus ciliata

02 RC 02 (02) Celery and Vernonia

Apium graveolens

(a) Mutation studies :

(i) Seeds of celery strain "RRL-85-1" were treated with various doses of γ-rays, ethylmethane sulphonate (EMS), sodium azide (NaN_3) and cytoplasmic specific mutagens like ethidium bromide (EB) and streptomycin (SM). M_1 and M_2 generations were raised in the field using standard agricultural practices. Segregating populations (M_2) are being screened for male-

sterility. Besides, progenies of two partially male sterile mutants which were isolated in the M_4 generations were carried forward to study their genetic behaviour in subsequent segregating generations (M_5).

(ii) Following treatment with various physical and chemical mutagens, M_4 progenies were analysed for variation in polygenic traits like seed yield and essential oil content. Seed yield varied from 30 to 45 gms/progeny whereas oil content of different progenies varied from 2.0 to 2.8%. Thus, both the characters exhibited considerable variation. Progenies with high seed yield/oil content as compared to control were selected and carried forward for comparison under replicated condition.

(b) Induction of polyploidy

Following seedling treatment with aqueous colchicine solution, polyploidy was induced in celery strain "RRL-85-1". Effect of genome doubling on various cytomorphological characters was studied in comparison to diploid parental strain. In general polyploids were inferior to diploids. Progenies of induced polyploids were carried forward to study their behaviour in C_1 generation.

(c) Agronomy

The effect of nitrogen (doses 40, 80, 120, 160 kg N/ha) in combination with irrigation levels 25, 50, 75 and 100 mm Cumulative Pan Evaporation (CPE) was studied on celery and the results revealed significant increase in growth parameters and yield of seed per hectare due to higher doses of nitrogen (120 and 160 Kg N/ha) and more frequency of irrigation at 25 and 50 mm CPE.

Vernonia

Plantations of *V. galamensis* and *V. lasiopus* were raised from selections and evaluated. Unlike *V. galamensis, V. lasiopus* seemed to adopt better under agroclimatic conditions of Jammu and no serious disease or insect pest was noted. Evaluation of the oil of both the species is given in Table 4.

Table 4 : Evaluation of oil of Vernonia species

Parameter	*V. galamensis*	V. lasiopus
Oil percentage	30-35	18-24
Saponification value	188.00	182.50
Iodine value	99.50	98.50
Unsaponifiable matter	3.50	2.00
Fatty acid composition by GLC (%)		
Lauric acid	0.52	2.34
Myristic acid	0.33	0.97
Palmitic acid	2.06	3.17
Stearic acid	0.29	0.86
Oleic acid	5.93	7.79
Linoleic acid	13.65	15.85
Arachidic acid	0.59	—
Vernolic acid	76.61	69.10

02 RC 02 (03) *Cymbopogon*

(a) Lemon grass (CKP-25)

IMPROVEMENT

(i) Induced mutation studies and conventional breeding work was continued. Screening and selection in M_1 and M_2 was done. In M_1 generation maximum variation of herb and oil yield was found in 40 kR whereas maximum variation in oil percentage was found in 30 kR whereas maximum variation in oil percentage was found in 30 kR of γ ray irradiation. In M_2 generation of clonal population, no visible mutants were observed. Selection was carried out on the basis of the herb and oil yield.

(ii) Four harvests of the second year crop of the comparative trial of F_2 and F_3 selections of Ckp-25 in comparison to the RRL-16 and Ckp-25 were taken. One of the F_2 selections Ckp F_2-38 was found to be promising and much hardier than Ckp-25. There was less mortality rate and the oil yield was at par with Ckp-25. This was selected for further agronomical studies (Table 5).

Table 5 : Comparative Yield of Different Varieties of Lemongrass

Strain	Yield of all the harvests of 1991				Survival
	per four plots (64 m^2)		per hectare extrapolated		%
	herb(kg)	oil (ml)	herb (tonnes)	oil(litres)	
Ckp-25	487.00	2352.00	76	367	66.0
Ckp-F_2-6	158.00	595.00	25	93	50.0
Ckp-F_3-93	566.00	1675.00	88	262	60.0
Ckp-F_3-53	302.00	890.00	47	139	35.0
Ckp-F_2-38	498.00	2428.00	78	379	75.0
RRL-16	622.00	1754.00	97*	274	75.0
SE	23.34	127.76	3.52	19.91	
CD	47.61	272.26	75	42.44	

* Significant at 5% level
Replications - four
Plot Size - 16 m^2
Area under each strain (4x16m^2) - 64m^2

AGRONOMICAL STUDIES

(i) *Effect of nitrogen, phosphorus and potassium* : Different doses of phosphorus (30, 60, 90, 120 kg P_2O_5/ha) and potassium (50, 100, 150 kg K_2O/ha) with constant dose of 200 kg N/ha and corresponding controls were

compared. The results of three harvests taken in July, September and December, 1991, indicated that maximum herbage and oil yield was obtained under the treatment combination of N_{200} x P_{120} x K_{100} without influencing the oil and citral content of the crop. The herbage (22.6, 25.8, 13.7 tonnes/ha) was obtained in the first, second and third cuttings, respectively. Thus, the oil yield obtained during first year was 283.8 kg/ha from the total herbage yield of 62.1 tonnes/ha.

(ii) *Effect of nitrogen* : On 3rd year crop, different doses of nitrogen (90, 140, 190, 240, 290 and 340 Kg N/ha) with control were compared. The results of four cuttings obtained during the year showed a significant increase in herb and oil yield over control at 190 kg N/ha. However, there was no significant increase in herbage and oil yield among the higher doses (240, 290 and 340 kg) of nitrogen. Maximum yield (84.3 T/ha herbage and oil 341.25 kg/ha) was obtained at 340 kg N/ha. Progressive decrease in oil content was observed with increase in nitrogen dose over control.

(iii) *Effect of zinc application*: Application of zinc (10 & 20 kg as basal and 0.3. 0.4, 0.5% as foliar) by both the methods showed considerable increase in oil content of the crop over control, being maximum (0.62%) with 0.3% foliar application resulting in oil yield of 276.25 kg/ha from the herbage of 57.34 T/ha.

(iv) *Effect of Triacontanol* : The effect of different concentrations of Triacontanol (0, 10, 20, 40, 60 and 80 ppm) was studied in third year crop. The results of the four harvests taken in May, July, September and November showed an increase of 13.76, 14.03, 21.3 and 16.1 percent in herbage yield in 1st, 2nd, 3rd and 4th cuttings respectively with the application of lowest concentration (10 ppm) over control. Herbage yield decreased with the increase in concentration beyond 10 ppm and higher doses at 60 and 80 ppm showed negative results in all the cuttings. However, oil and citral content of the crop remained unaffected by the different concentrations of triacontanol.

(v) *Effect of spacing* : The treatment of five inter-and intra-row spacings namely 30 cm^2, 30x40 cm, 40 cm^2, 40x50 cm and 50 cm^2 were studied on a third year crop. Four cuttings were obtained during the year and the results showed that maximum production of herbage (76.0 T/ha) and oil yield (355.17 kg/ha) was obtained under the spacing of 40x50 cm. However, these yields were not found significantly higher over other spacing combinations. The oil and citral content of crop was not effected with the different plant densities.

(b) Jamrosa : Two citral deficient mutant clones JR-48 and JR- 187 of Jamrosa were evaluated for their agronomic performance. The data regard-

ing fresh herbage and oil content obtained in these cuttings in the first year showed them at par with the parent clone.

(c) Control of the diseases of Cymbopogon species : Collar rot and root rot diseases were observed at Chatha farm and a commercial farm at Nagbani, Jammu. The causal agents were identified as a non-sporulating species of basidiomycotina, *Fusarium oxysporum* and *Rhizoctonia solani*. *In vitro* testing of fungicides namely Dithane M-45, Dithane Z-78, Bavistin, Carbestin, Kitazin, Topsin and Fytolan at three concentrations (0.1, 0.2 and 0.3%) showed that systemic fungicides namely Carbestin, Bavistin and Kitazin could inhibit completely the radial growth of the pathogens. Application of these fungicides before transplanting the slips into a new field/area is thus suggested to avoid the source of inocula of the pathogens.

02 RC 02 (04) Saffron Breeding and Agrotechnology

(a) Tissue Culture

Morphogenetic studies primarily for developing efficient methods for regeneration of saffron plants were continued. Scanning electron microscopy of various stages of somatic embryo development (Globular, Heart shaped and Torpedo) confirmed gross developmental sequences of plants regeneration through somatic embryogenesis. Various experiments were conducted to improve germination of somatic embryos and their differentiation into plantlets. Transfer of embryogenic calli to different strength liquid basal media fostered maturation of 30-40% embryos and singulate embryos. Among the various sizes (2.5 - 8 mm) and growth hormone treatments radicle emerged from 80% of embryos but the frequency of formation of both root and shoot was low. On an average 10-20% of somatic embryos showed both root and shoot. Somatic embryo developed into complete plantlet in one of the tried combinations of the media.

In order to improve the frequency of embryo formation and for better understanding of metabolism involved in embryogenesis, embryogenic suspension cultures were raised. Among biochemical parameters studied, increased protein synthesis in embryogenic cultures (2.47 µg/mg of tissue) as compared to non embryogenic callus (0.69 µg/mg of tissue) also depicts embryogenic nature of saffron tissue.

(b) Plant breeding and agrotechnology

(i) *Fertilizer response*. The experiment was laid out in a split plot design with four replications to study the effect of phosphorus (30, 70 kg/ha), potash (20, 30, 40 kg/ha) applied singly or in combination at planting and subsequently every year at weeding time in June. The experiment was laid in raised beds of 3.0 x 3.6 m size. The yield data is given in Table 6.

Table 6 : Fresh Flower Yield of Saffron (in grams/11 sq.m.)

Treatment	Year		
	1989	1990	1991
P_0K_0	17.20	50.90	120.70
P_0K_1	20.30	52.00	127.40
P_0K_2	24.80	68.00	164.20
P_0K_3	24.40	75.00	171.40
P_1K_0	33.10	69.48	145.30
P_1K_1	35.00	71.00	156.40
P_1K_2	21.20	60.30	125.30
P_1K_3	19.48	66.00	120.40
P_2K_0	23.90	52.80	113.70
P_2K_1	26.50	62.10	127.08
P_2K_2	24.80	57.68	127.50
P_2K_3	24.20	61.70	127.90

Mean of 4 replications

(ii) *Effect of size of corm* : Healthy corms of saffron were carefully measured/weighed and categorised into 5 different lots before planting. In each lot 400 corms in four replications of hundred each were planted in rows in raised field beds. The yield data is given in Table 7 .

Table 7 : Influence of Size and Weight of Corm on the Yield of Flowers in Saffron

Corm at planting time		Fresh flower yield (gms)		
Diameter (cm)	Weight (gm)	1989	1990	1991
1.0	3.0	0	0.86	3.61
1.5	3.8	0	9.63	33.40
2.0	6.4	0.80	21.20	51.26
2.5	8.5	5.64	24.40	59.80
3.0	11.6	7.13	27.63	63.60
3.5	16.4	9.12	30.40	70.35

(iii) *Radiosensitivity studies* : Pre-sowing exposure of corms to different levels of X-radiation (500-25000 R) caused a dose dependent decrease in number of leaves/cluster, flowers/100 corms and number of daughter corms per mother corm. This adverse effect of radiation was also manifested in decreased flower yield in three years of experimentation. The concentration of the pigments, however, recorded a mild increase in saffron flowers harvested from treated material.

(c) Evaluation of fungicides for the control of corm rotting of Crocus sativus

Eleven fungicides namely Arasan, Bavistin, Brassicol, Captaf, Carbestin, copper sulphate, Dexon, Delsan, Fytolan, Kitazin and Dithane M-45 with two concentrations (0.1 and 0.2 %) were evaluated against the most virulent strain of a species of Basidiomycotina causing corm rotting under *in vitro* conditions. The results indicated that 0.2% Arasan, copper sulphate, Dexon, Delsan, Kitazin, Fytolan and Dithane M-45 checked the radial growth completely. These selected fungicides were further tested with higher concentrations (0.3, 0.4 and 0.5%) under *in vitro* conditions. Each treatment consisted of 5 corms with two replications. These fungicides at higher concentrations were tested under three incubation periods by dipping the corms upto 10, 30 and 60 minutes in water suspensions. These treated corms were sown on sand nutrient culture and allowed to grow from 8 November 1991 to 27 February, 1992. All the corms under treatment sprouted and they showed no sign of phytotoxicity. These fungicides were found to be the most effective and can be used for treating the corms upto the duration of 60 minutes before sowing. All the treated corms produced very healthy vegetative parts.

02 RC 02 (5) Development of New Varieties of Hops and Their Culture

(i) *Evaluation studies*: Performance of trial on hops laid out at four new locations *viz.* Leh, Bhaderwah, Keylong and Budhal was monitored during the growing season (Table 8).The plants showed brisk growth with sufficient lateral development at two experimental sites in Leh (A, B). The average cone size at sites A and B was 4.6 cm and 3.8 cm and the alpha-acids content was 12.31% and 11.22% respectively.

Table 8 : Cone Size and Soft Resins Content in Hops Grown in Different Experimental Sites

Location	Cone		Soft-resins	
	Length (cm)	Breadth (cm)	Alpha-acids (%)	Beta-acids (%)
Leh				
Site (A)	4.6	2.0	12.31	10.52
Site (B)	3.8	2.0	11.22	8.48
Bhaderwah	3.5	1.5	6.50	6.30
Keylong	3.8	1.8	10.00	6.60

At Bhaderwah the plants of variety Late Cluster and Talisman reached top wire in the first year but exact behaviour could not be recorded due to late planting. However, the cones showed proper development. The density of lupulin glands was moderate with an average alpha - and beta acids of

6.5% and 6.3% giving a ratio of 1:1 (α : β) which is an attribute in a variety from brewing point of view.

(ii) *Cytological studies* : Chromosome morphology of a male hop accession, found growing wild in Kashmir was undertaken. A haploid chromosome number of n=10, comprising 9 autosomes+1 sex (X or Y) chromosome was found at pollen mitosis. The 9 chromosomes (autosomes) consisted of 2 median, 5 submedian and 2 subterminal type. In addition to n=10 chromosomes 23% grains contained n=11 chromosomes. Such hyperhaploid (n+1) pollen differentiating from nuclei bearing n=10 are generally involved in the evolution of the primary trisomics.

As regards sex chromosomes, a simple XY type was found. The X chromosome was submedian with euchromatic gap in the middle region of short-arm. Whereas Y chromosome, having submedian centromere, was the shortest chromosome of the complement. Based on the chromosome morphology, Y chromosome in the present male strain is of wing type (Y^W). The cytological studies reveal it to be an evolutionary advanced strain.

(iii) *Extension work* : Technical folder on the cultivation of hops was compiled as a guide for hop growers. A short-term training course on cultivation and post-harvest processing of hops, at the request of Hops growers marketing society, was organised at Keylong, Lahaul and Spiti (Himachal Pradesh) from August 14 to 20, 1991. Lectures on various aspects of hops culture like designing of trellis, raising of disease free nurseries, agrotechnology, post-harvest processing, were given to 200 prospective growers. Field demonstrations were held in four villages *i.e.* Kirting, Jalma, Beeling and Lote.

02 RC 03 Exploratory Studies on *Picrorhiza kurroa*

In addition to Srinagar, new areas were explored for the domestication studies. Germplasm from Rohtang and Garhwal was procured and planted at Forest Nursery, Kud. Insect damage was brought under control by dusting of BHC. Initial mortality rate of Kud plantation was high (60%).

Random samples were drawn from germplasm collected from H.P. and Garhwal. The samples of rhizomes and roots were drawn from one year and two year old plants from Srinagar cultivated stock. Chemical analysis revealed that germplasm from Toshmaidan (Kashmir) and Garhwal (U.P.) is more or less similar. In cultivation there is no significant increase in kutkin content in first two years of plantation at Srinagar (Table 9).

The chemical analysis revealed that on an average rhizomes contain double kutkin content as compared to roots. The plant responded well to the treatment of growth hormones.

Table 9 : Percentage Kutkin in *Picrorhiza kurroa*

(a) Wild germplasm

Germplasm source	Part	Collection date	Percentage of kutkin
Rohtang (H.P.)	Rhizome	June, 1991	0.60
Keylong (H.P.)	Rhizome	June, 1991	0.70
Keylong (H.P.)	Root	June, 1991	0.40
Garhwal (U.P.)	Rhizome	Aug., 1991	1.00
Garhwal (U.P.)	Root	Aug. 1991	

(b) Cultivated Stock

Stock	Part	Age	Percentage of kutkin
Toshmaidan (Kashmir)	Rhizome	1 year	0.85
Toshmaidan (Kashmir)	Root	1 year	0.33
Gurez (Kashmir)	Rhizome (GA_3 treated)	1 year	0.88
Gurez (Kashmir)	Root (GA_3 treated)	1 year	0.41
Gurez (Kashmir)	Rhizome	2 year	0.78
Gurez (Kashmir)	Root	2 year	0.45

02 RC 04 Cell Culture of Ratanjot

Live *Onosma echioides* plants were obtained from Ladakh and Srinagar regions and cultured on various media formulations. Callus cultures having mixed population of white, green, pale yellow and brownish-red cell masses were obtained. Pure lines having one colouration callus were isolated and maintained periodically. Two compounds, the major one shikonin acetate and dimethylacryl shikonin were isolated and identified. HPLC and spectrophotometric methods were standardised for quantitative analysis of total shikonin derivatives. Mother cultures of *Onosma* contained 0.25% total shikonin derivatives on dry weight basis. Following studies regarding regulatory aspects of growth and shikonin production were assessed.

(i) *Improvement of culture strains* : Cell lines *i.e.* 0-1 to 0-120 were isolated by repeated clonal selection carried out by cell- aggregate cloning method. The culture whose total shikonin content was 0.25% on dry weight basis was used as mother culture. This shikonin content is half as much as the content in the intact roots of parent plant. Of 120 clones isolated from other callus, 39% did not produce any red pigment, while the rest 61% showed wide variation in both pigment content (traces to 2% dry weight) and cell growth.

(ii) *Induction of organised globular structures* : The control of cell organization, differentiation and product formation are often inter-related In many cases secondary products are formed in cultures of organized tissues in higher yields as compared to suspension cultures. As a consequence,

medium formulation was developed and a culture line was isolated which grew in semi- organized fashion *i.e.* organised globular structures (OGS).

(iii) *Induction of rhizogenesis* : A culture line was isolated, established and maintained and medium formulation developed for the growth of multi-point root culture type of *O. echioides*.

(iv) *Improvement of production medium* : Experiments regarding effect of chemical parameters *i.e.* different basal medium formulations, nitrogen source and concentration,carbon source and concentration on cell growth and total shikonin derivatives production, were undertaken.

03 NATURAL PRODUCTS (CHEMISTRY)

03 RC 03 Screening of Plants for Edible Colours

(i) A process for the isolation of safflower yellow and carthamine from the plant No.031 has been developed. Both the colours are food colours. Safflower yellow is water soluble and carthamine is alcohol soluble.

(ii) Xanthophyll and its esters are extensively used as colourant in food industry. Its oil soluble extract is quite stable at room temperature. A process for the isolation and estimation from plant (Code No.042) has been worked out.

04 BIOTECHNOLOGY

04 RC 01 Production of Microbial Oils and Fats

Fungal strain MR-2 was grown in potato dextrose broth with 50, 100 and 200 g/l glucose concentration. Biomass production of 7.21, 10.23 and 9.35 g/l was observed in above three glucose concentrations. Maximum lipid production was 1.44 g/l. Experiments were also conducted in which potato dextrose medium was supplemented with yeast extract. Growth and lipid production remained same.

Studies with MI-74 and 84 strains

Two strains MI-74 and MI-84 were tested in control medium for biomass and lipid production. Both the strains produced similar biomass and lipid in the region of 32 and 10 g/l respectively.

Further studies were undertaken with MI-84 by growing it in Suzuki Yokochi's medium and control medium with varying glucose concentrations *i.e.* 100, 150 and 200 g/l.The control medium with 150 g/l glucose resulted in increase in the biomass and lipid to 44.6 and 17.6 g/l respectively. The fatty acid analysis of fungal oil from MI-74 showed accumulation of 18:1

(24.7%), however the gamma linoleic acid accumulation was only 2.4%. MR-2 was grown in 10% glucose in modified control medium. 168 hrs. of fermentation yielded 24.7 g/l biomass and 6.4 g/l oil. Incubation for 240 hrs yielded 46 g/l biomass and 12.0 g/l lipid.

Media tested for biomass and lipid production

Five different media M-2, M-3, M-5, M-6 and M-7 of varying compositions were examined for growth and lipid production by MR-2 in shake flask. Medium No. 2 with 100 g/l glucose gave highest biomass and lipid production *i.e.* 32.96 g/l and 10.76 g/l respectively. The biomass of M-6 and M-7 grown culture approached equal to that in medium M-2 but their lipid production was lower than that of the M-2 medium(Table 10).

Table 10 : Biomass and Lipid Production by Different Media

Medium	Medium Sugar	Maximum	
	(g/l)	Biomass (g/l)	Lipid (g/l)
M-2	100	32.96	10.76
M-3	100	18.98	4.82
M-5	100	6.56	0.45
M-6	100	26.17	7.76
M-7	200	24.50	2.90

Bioreactor studies

In order to scale up the results obtained in shake flasks experiments were conducted in laboratory scale fermenters. The results obtained in shake flasks suggested that in M-2 the fermentation cycle is faster. Results have been listed in Table 11.

Table 11 : Studies with Different Media in Shake Flasks

Medium	Initial sugar(g/l)	Sugar consumed (g/l)	Biomass (g/l)	Lipid (g/l)	GLA (%l)	GLA (g/l)
M-II (168 hrs)	107	84	20	7.90	5.56	0.439
M-VII(168 hrs)	213	84	24	5.29	5.70	0.300
M-VII(72 hrs)	175	65	21	2.80	13.40	0.375

In an attempt to optimise rpm for growing the fungal in bioreactors 200, 300, 400, 500 and 600 rpm were studied. It has been observed that higher rpm gives better consumption of sugar as well as biomass and lipid production. This probably was due to better oxygen transfer rate at higher rpm in the viscose mycelial population.

04 RC 02 Construction of Genetically Altered Organism for L- ascorbic acid Production

Genetically altered organisms obtained by fusion of 2,5- diketogluconic acid producing strain of *Gluconobacter* sps. and sterospecifically "ketoreducing strain of *Brivibacterium* sps. were studied for 2-keto-L- gulonic acid (2-KLGA) production. Various monosaccharides were used as the substrate. While D-glucose and D-sorbitol were directly oxidized (through non-phosphorylative pathway) all other saccharides only supported the growth. The profile of 2-KLGA production by a selected fusant using D-sorbitol as the substrate is shown in Table 12 .

Table 12 : 2-Keto-L-gulonic acid Production from D- sorbitol by a Selected Fusant

C_s	C_{acid}	C_p	T(h)
20	19	4.0	17
25	23	7.5	19
50	40	9.0	23
50*	46	16.6	25
100	55	11.0	40

C_s = Concentration of D-sorbitol (g_{-1-1}).
C_{acid} = Total acid produced (g_{-1-1}).
C_p = 2-KLGA produced (g_{-1-1}).
T(h) = Fermentation time in hours.
* = Fermentation made under oxygen enriched condition.

Restriction map of the plasmid and the total DNA finger print of *Gluconobacter oxydans* were studied and the representative chromatograms are shown in Figs. 1 & 2 respectively. Genomic library of *Gluconobacter oxydans* using a cosmid vector has been developed in *E. coli* and is being screened.

Identification of pesticide degradation determinants in Pseudomonas sps

The capability of strains of *Pseudomonas ovalis* and *P.tralucida* to grow on hexachlorocyclohexane(HCH), a chlorinated pesticide, as sole source of carbon and energy, was eliminated by treatment with curing agents such as mytomycin C. Presence of plasmid in HCH+culture and loss of degradative pathway and physical presence of plasmid upon curing indicate the extrachromosomal location of HCH degradative genes in *P. ovalis*. Furthermore, the HCH+degradative determinants of strains of *P. ovalis* and *P.tralucida* could be transferred to cured or other HCH-*Pseudomonas* sps by conjugation without the transfer of any chromosomal marker.

Fig. 1 — Restriction endonuclease digestion of the plasmid DNA of *G. oxydans*. 1% agarose gel prepared in 1X TAE buffer was used for the analysis of the DNA fragments

1. Lamda DNA Hind III digest as marker:
2. *G. oxydans* uncut plasmid as control:
3. — plasmid digested with Apa I;
4. — — — — Acc I;
5. — — — — Eco R I;
6. — — — — Sca I;
7. — — — — Pvu I;
8. — — — — Cla I;
9. — — — — Bam H I;
10. — — — — Hinc II;
11. — — — — Hind I;
12. — — — — Sal I;
13. — — — — Bcl I;
14. — — — — Sac II;
15. Lambda DNA Hind III digest as marker.

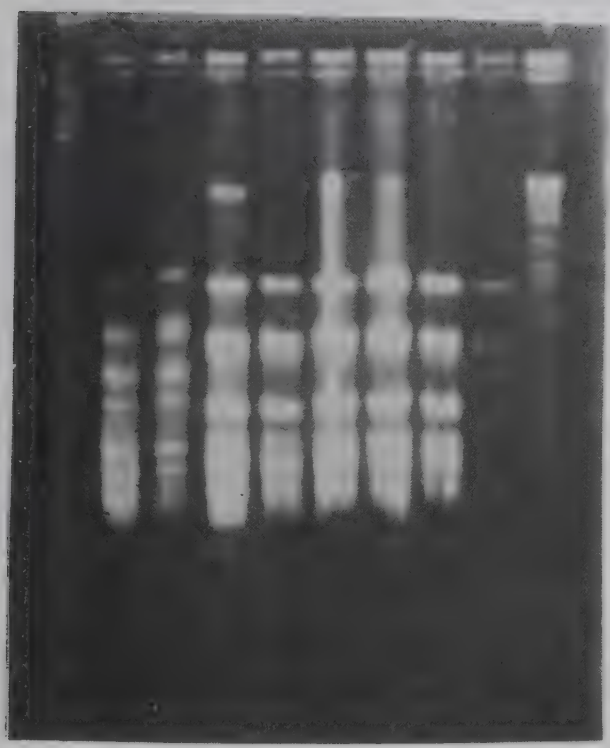

Fig. 2 — Pulse-field electrophoretic analysis of the Hind III digested total DNA of *Gluconobacter oxydans* ATCC 9937

05 POST-HARVEST TECHNOLOGY OF REGIONAL AGRO-HORTICULTURAL PRODUCE

05 RC 01 Post-harvest Studies on the Factors Affecting the Quality of Saffron (*Crocus sativus* L.)

(a) Modified air classifiers for the separation of petals, stigmas and stamens

Based on the principle of projected areas and air differential pick up velocities of stigmas, stamens and petals, the air classifier has been modified to blow air at 90° across the cut flowers to segregate the components. In tubular model, a tromel is built of two sieve sizes (6 mm x 6 mm and 1.5 mm x 1.5 mm). This is fitted inside the duct and the tromel is rotated at 10 rpm. In order to give inclination to the path of falling material, serrated vanes are provided in the path of cut flower fall at 70° angle. The air flow is adjusted at 200 metres/min. The output of equipment is 5 kg/hr. In the vertical model, the height of fall was increased to 900 mm for better segregation of flower components. The models were tried in the field and gave satisfactory results.

(b) Field training

A field training was organized at Berwar in Kishtwar, to disseminate practical information on improved post-harvest handling and processing of saffron. The programme was directed towards the production of international quality saffron, as well as rural upliftment and employment generation. The participants (including progressive farmers and those working at grass root level) were imparted training on modern technologies developed at RRL, Jammu, which included mechanical Laccha separator; flower harvestor, saffron flower air classifier; solar drier, packaging and storage techniques. The programme aroused a great response among saffron growers in Kishtwar region.

05 RC 02 Development of Processed Diabetic Foods

(a) Standardization of process for canned peaches for diabetics

Conventional canning of peaches is done in a syrup containing 50-55% sucrose. However, such high sugar product cannot be recommended for the patients suffering from diabetes. Investigations were undertaken to find an additive suitable as substitute for sugar syrup. Liquid sorbitol in different concentrations was attempted as covering liquid for the canning operation.

Fully ripe peaches were treated with a boiling lye solution containing 2.0% sodium hydroxide for 40 sec., subsequently washed in plain water and

treated with 0.5% HCl followed by rinsing in water. Sorbitol was used in covering syrup in concentrations ranging from 40 to 60% along with 0.5% citric acid. The fruits were packed in 1 lb plain tall cans following the standard procedure of canning.

After storage at ambient temperature for 20 days, the cut out examination was conducted and product analysed. Sorbitol concentration (40-60%) in the covering liquid had insignificant effect on the drained weight of the canned fruit as compared to control lot with 55% sucrose in covering syrup. Data on the sensory evaluation indicated that sorbitol concentrations of 50% and 60% in the covering liquid produced quality attributes *i.e.* colour, flavour and texture comparable to conventional produce of the canned peaches. However, scores for taste (5.1 to 5.5) were found to be on the lower side as compared to control scoring 6.2 marks. Investigation showed that with a superior variety of peaches, better product could be obtained.

Storage studies revealed that there was no significant change in the drained weight (50.3-50.7%), acid content (0.41-0.43%), brix (21.3-31.2 degrees) and brix/acid ratio (48.8-72.5) of the covering liquid of the canned product after 9 months of storage at ambient temperature. The sensory quality of the canned product with 50-60% concentration of sorbitol in covering liquid also had colour, flavour and texture comparable to the control lot. However, the taste attribute was found to be inferior. The observations on storage studies are well in agreement with earlier experiments indicating that effect of storage period upto nine months is insignificant on the quality attributes.

(b) Improvements in the quality of mango RTS

Body of a beverage is an important quality attribute. In continuation of experiments conducted on standardization of diabetic RTS, effect of incorporation of different hydrocolloids on the beverage quality was investigated. Samples of mango RTS were prepared using pectin as per the conditions standardized earlier. Different Genu pectin types, *viz.* LMP-101 AS, 102 AS, 104 AS and 101 AS-JS were incorporated in concentrations ranging from 0.1 to 0.4% and their effects monitored on the beverage body in terms of viscosity. The effect of hydrocolloids on organoleptic attributes was also evaluated. The data for viscosity measurement showed that all types of LM Pectin, on incorporation upto 0.2% level, increased the viscosity by 242.8% to 285.7% over control and thereby improved the product body. At this concentration, all types of LM pectins were found to improve the taste and mouth feel of the RTS. Addition of hydrocolloids beyond 0.2% level, though found to increase the viscosity and improve the product body, had deleterious effect on the taste and mouth feel. The data showed that Genu LM pectin 102 AS, 104 AS, 101 AS-JS can advantageously be used to improve the quality of mango RTS.

(c) Standardization of fruit punch for diabetics

Investigations were undertaken to improve the quality attributes viz taste and body of the chemically preserved fruit based drink. Sucrose contributes to the positive hedonic response, provides body and clean sweet taste to the product. However, non-nutritive sweetner, *i.e.*, aspartame was investigated with varying concentrations along with the sorbitol.

Effect of aspartame on the quality of fruit punch. Fruit punch samples containing 25% pulp with equal quantities of apple, plums, mango and gal'gal and 30% sorbitol was prepared using the standardized procedure. Aspartame was added in concentration ranging from 500 to 2500 ppm along with 0.6% acid in the beverage. The data showed that product containing 30% sorbitol and 0.6% acidity and 1500 ppm aspartame was found to be most acceptable. At higher concentrations, the additive added undesirable sweetness.

Effect of hydrocolloids on the bodying quality of fruit punch. To improve upon viscosity and flavour of the diabetic fruit punch, modifying food additives *e.g.* sodium alginate and carboxy methyl cellulose were attempted.

Addition of sodium alginate even upto 0.3% level was not found to improve the flavour and mouth feel of the product though it insignificantly helped in increasing the viscosity (4.4 C.P. at 30°C) as compared to control lot (3.5 C.P.). CMC was observed to increase the body of the product significantly with the increase in concentration of the hydrocolloid. CMC added to the flavour and mouth feel upto 0.3% concentration and increased viscosity upto 5.9 C.P. as compared to control (3.5 C.P.). Further increase in concentration adversely affected the flavour and mouth feel. The data showed that CMC can be added advantageously in the fruit punch in the range of 0.2-0.3%.

05 RC 04 Post-harvest Technology of Wild Pomegranate (*Punica granatum*)

Composition and quality of anardana at three stages of fruit maturity

The relative quality of the fruits at different stages of maturity was evaluated on the basis of composition, size and colour of arils. The fruit reached horticultural maturity for the commercial harvest when the fruit size varied from 4.6 to 5.3 cm dia., the total soluble solids (TSS) attained a fairly constant level of 21% and the colour of the arils becomes bright red. The level of titrable acidity remained almost stable at the same time that T.S.S. reached 21% and the colour of the arils continued to increase in intensity as the maturity progressed. There was no significant variation in moisture, *p*H, ash, N_2, crude fibre and sugar contents.

Drying and dehydration of wild pomegranate seeds

The depth of layer in cross-flow drying was 5.2 mm, spreading density 3 kg/m^2, inlet humidity 47%, exit humidity 80%. The sample took 4 hr for drying at 60±5°C. It took three days for drying in improved Solar Dryer. The samples were also dried under vacuum (0.4 kg/cm^2) at 55° and took 4 hrs for drying.

Studies on lipids in pomegranate seeds

The characterization of total lipids of anardana seeds was done and the results are given below:

Total lipids content	9.52%
Refractive index (37.5°)	1.535
Acid value	4.179
Saponification value	128.823
Unsaponifiable matter(%)	1.535
Iodine value	215.095
Free fatty acids (% as oleic acid)	2.1

The gas chromatographic analysis indicated that presence of the common fatty acids [C_{16} to C_{20}]. Palmitic ($C_{16:0}$), Oleic ($C_{18:1}$) and Linoleic ($C_{18:2}$) were the three main fatty acid esters among those identified. This is in agreement with the reported data on seed oil from table variety of pomegranate. The GC graph showed two major but unidentified peaks after arachidic ($C_{20:0}$) peak. The oil also indicated small peaks of stearic ($C_{18:0}$) and arachidic ($C_{20:0}$) fatty acid esters.

TLC of mixed fatty acid esters (Castor, *Vernonia* species, groundnut) and anardana seed oil, using developing solvent ether : acetic acid (70:30) revealed the absence of oxygenated fatty acids. This further indicated the presence of phospholipids and non-polar lipids. There was no inclination of any glyceride with oxygenated functional groups like hydroxy, keto etc.

Anthocyanins and other phenolic compounds of wild pomegranate

The anthocyanins of wild pomegranate arils are important aesthetically and economically, because they are located in the flesh of the seed and their stability is of significance in marketability of processed products such as dried anardana and instant powder. The work was undertaken to identify the major anthocyanin pigments and phenolic compounds in processed pomegranate seeds.

High performance liquid chromatography was applied to separation of anthocyanins and related compounds of processed anardana seeds. The solvent system and elution profiles used for separation of pigments were

formic acid-water (5:95) and methanol. Detection of peaks was performed at 330 nm. The extracts were dissolved in formic acid-water and also in formic acid-water containing 0.01% HCl.

In frozen wild pomegranate juice 4 major peaks having retention times 3, 3.7, 5 and 42.5 min were observed. The peak with 42.5 min retention time was much higher when detected in acidified formic acid-water solution. This shows that this peak is that of anthocyanidin. By comparing the retention times of frozen sample to those of anthocyanins/polyphenols reported in literature, it can be seen that peaks at 3 min and 42.5 correspond to gallic acid and pelargonidin chloride, respectively. In solar dried anardana extract 7 peaks at 3, 4, 4.5, 16, 17, 42.5 and 44.5 min retention times were observed. The peaks at retention times 3, 16, 17, 42.5 and 44.5 indicate the presence of gallic acid, quercetin, pelargonidin 3,5-diglucoside or malvidin 3,5-diglucoside, pelargonidin chloride and malvidin chloride, respectively. There was no significant difference in the peaks of the extract in acidified medium. In roller dried anardana flakes extract, 8 peaks at retention times, 3, 3.8, 4.5, 5.8, 16, 17, 42.5 and 44.5 were observed. The comparison of retention times of peaks correspond to the compounds present in that of solar dried sample. There was no change in number of peaks in acidified medium.

Changes in pigments of processed anardana samples during storage

The juice from fresh anardana seed was freeze dried in Cherist- Gamma IA freeze dryer at –40°C for 36 hr. The absorption changes were recorded on UV/Vis. spectrophotometer between 200 and 600 nm. Two peaks at 255 and 270 nm were observed in methanol extractive. Further three peaks were observed in acidic MeOH (0.2% HCl) at 263, 370 and 530 nm.

In a set of experiments 1g processed anardana/powder sample each of solar dried, dried at 60±5°C, dried at 80±50°C,vacuum dried at 55°C and roller dried flakes were extracted with acidified ethanol for 48 h and made upto 100 ml volume. The O.D. values (initial) ranged from 0.033 (Solar dried) to 0.149 (Roller dried) at 530 nm. The results indicate that increased temperature and low thermal processing time produce an increasing stability of anthocyanin pigment.

Equilibrium relative humidity studies

With an initial moisture content of 8.7% and R.H. 11.1% there was no change in colour (darkening) and texture of anardana powder, while at R.H. 31.9% and above slight caking took place and colour also darkened. Mold growth appeared in the sample kept at R.H. 79.1%, after 1 month storage

Chemical composition of wild pomegranate juice/seeds

Values for chemical composition of fresh juice include brix 21%, titratable acidity (as citric acid) 4.22%, reducing sugars 9.33%, non-reducing sugars 3.07%, total sugars 12.40%, protein 1.4% and ether extractive 0.026%. The seeds contain alcohol precipitated pectin 17.92%, methoxyl content 2.17%, equivalent weight 588.23, total ash 3.3%, alkalinity 0.3% and moisture 7.5%.

The chemical examination of insect infested anardana seeds showed the reduction in sugar and fat contents. The values observed were, total sugars 6.34%, reducing sugars 0.54%, non- reducing sugar 5.80%, protein 11.025%, moisture 8.0%, fibre 18%, fat 3.46% and total ash 3.36%.

Anticomplimentary activity

The neutral polysaccharides (1.17%) and acidic polysaccharides (0.22%) fractions isolated from the solvent extracted anardana powder have exhibited anticomplimentary activity.

Chemical characterization of market sample

The chemical composition of anardana seeds was studied and the result indicated-moisture 9.81%, titratable acidity (as citric acid) 12.67%, protein (Nx6.25) 6.31%, tannic acid 1.6%, alcohol insoluble solids 47.03%, total sugars 15.77%, reducing sugars 12.92%, non-reducing sugars 2.71%.

Development of instant anardana paste

The dried seeds of anardana were cleaned, washed and soaked in water (1:1 w/w) and ground to a fine paste (60 mesh). The paste was heated to 80^{o} and filled in sterilized glass jars. Sodium benzoate at 200, 300, 400, 500 and 1000 ppm levels was added in five sets of experiments, at the final stage of preparation. Two controls were run, one stored at room temperature (21.9^{o} to 38.5^{o}C) and the other at 5^{o}C. The samples with 200 to 400 ppm sodium benzoate were spoiled within 7 days of storage at ambient temperature. The control sample stored at 5^{o}C also got spoiled after 20 days storage. Samples preserved with 500 and 1000 ppm sodium benzoate were analysed for *p*H, total acidity and reducing sugars after 15 and 45 days interval. The observations on visible mold growth were made.

The results indicate that for safe storage, a minimum level of 500 ppm sodium benzoate is required to be incorporated. There was slight increase in acidity (0.13%) and significant decrease in the reducing sugar content during storage.

New technology for manufacture of instant anardana powder

The fresh anardana seeds were made into pulp in electrically operated grinder and dried in the roller dryer. The chrome coated roller was steam heated at 35 lb/sq. inch steam pressure. Films of pulp (1 mm thickness) took 160 seconds for drying. The final moisture content of the product was 5% and uniform red coloured flakes were obtained. Quality evaluation of instant anardana powder is in progress.

Development of equipment for separating seeds from fruit skin

The equipment (375 mm dia centrifugal extractor) comprising a feed hopper for pomegranates and perforated drum with 20 mm holes, side covered with 20 mm welded mesh and impact elements mounted at 45° to the drive shaft increased the % seed yield. The equipment was run with single phase 3/4 H.P motor and gave a yield of 75% intact seeds at 400 rpm. The equipment is being further modified to increase the yield of seeds extraction.

06 MUSHROOMS

06 RC 01 Investigations on Mushrooms

(a) Morchella

(i) Effect of leaf extracts: Out of 12 leaf extracts tried at 1.5% concentration the extracts of poplar, pear and plum gave significantly better mycelial yield (Table 13).

Table 13 : Effect of Different Leaf Extracts on the Mycelial Growth of *Morchella* species

Leaf extract of	Average dry mycelial weight (mg)
Chinar	144.0
Pear	168.5
Plum	171.0
Peach	154.5
Poplar	177.0
Willow	162.5
Mulberry	162.5
Rose	137.0
Artichoke	124.0
Hops	109.0
Cherry	128.5
Oale	140.0
Control	130.66
C. D.	±33.63

(ii) *pH of the medium* : Better mycelial yield was obtained at *p*H 7.0.

(iii) *Effect of different concentrations of malt extract*: Higher concentration of malt extract gave profuse and dense mycelial growth on solid substrate.

(b) Cultivation of other edible mushrooms

(i) *Lentinus edodes* : Experiments were conducted by growing two strains of *L. edodes* (OJP, SKI) on sawdust substrate supplemented with wheat bran ranging from 20-60%. The results obtained have shown that increase in percentage of wheat bran increased the yield in both the strains. However, statistically signifcant results were obtained with strain OJP (Table 14).

Table 14 : Yield Performance of Two Strains of *L. edodes* with Different Percentage of Wheat Bran

Wheat bran	Mean yield of 100 g of dry substrate	
(%)	OJP	SKI
20	66.94	38.04
30	78.94	54.75
40	83.74	83.90
60	102.83	102.89
C. D.	±4.57	±28.84

(ii) *Flammulina velutipes* : Studies were undertaken on five different substrates wherein observations of the various morphological parameters were taken into consideration. The substrate No.II was found to be best (Table 15).

Table 15 : Morphological Parameters of *F. velutipes* on Five Substrates

Substrates (Code No.)	Stipe length (mm)	Stipe thickness (mm)	Diameter of cap (mm)	Wt. of fruit (body wt. in mg)
I	25.4±0.72	1.82±1.29	13.83±0.65	145.1±39.28
II	39.5±1.72	2.76±0.12	16.42±0.84	418.0±56.00
III	25.6±1.05	2.48±0.115	17.72±0.12	339.0±30.75
IV	20.44±0.81	3.2 ±0.173	14.04±0.53	234.2±12.25
V	36.26±0.68	3.20±01.01	17.76±2.53	255.8± 3.28

(c) Survey of fleshy fungi

Survey and collection of wild mushrooms was carried out in the new forest regions in Bhadarwah, Patnitop-Sanasar ranges of Jammu and also extended to Dharamsala- Medoligung, Palampur forests of H.P. A total of 326 collections belonging to several groups of fleshy fungi were preserved,

45 of them were determined to specific level and are new records for India. Some interesting species located are :

Agaricus nivescens
A.lotensis
Cortinarius purafulmineus
Lactarius piperatus
Lentinus lepideus
Lepiota alba
L. cbypeolaria
Leucopaxillus gagantea
Scleroderma verrucosum

Supplied 12 kg (dried) wild mushrooms of different species for chemical and biological investigations.

07 UTILIZATION OF MINERAL RESOURCES

07 RC 01 Utilization of Gypsum

(a) Gypsum coir boards (Work sponsored by Coir Board of India)

A semi-automatic demonstration plant for manufacturing gypsum coir boards was designed and a part of it was got fabricated. Efforts were made to scale up the process of manufacturing boards with a view to convince the entrepreneurs for commercial exploitation.

A pamphlet on gypsum coir board highlighting the technological properties, economics, raw materials availability etc. was designed and printed for distribution to motivate the entrepreneurs to manufacture and architects to use these boards in modern constructions. The findings were also disseminated to participants in a Workshop organized at Bangalore by Coir Board of India for this purpose exclusively.

Gypsum coir board false ceiling was put up in a room of the Laboratory allotted to State Bank of India, to study the thermal comfort created by these and also to serve as demonstration for local entrepreneurs.

(b) Cement coir composite boards

Coir Board of India has also sponsored a project for utilization of coir fibre with cement as a binder for making cement coir composite boards Number of experiments were carried out under different conditions like cement coir ratio, pressure, additives etc. in order to find out the optimum result.

(c) Artificial marble

Artificial marble tiles were prepared from Keene's cement. Different inorganic binders and polyester resins were tried to improve the strength, scratch resistance and water resistance of these tiles.

(d) Special grade plaster of Paris

Number of experiments with different parameters like concentration of solution, digesting time etc. were tried for making Plaster of Paris from locally available gypsum mineral. The product obtained was tested according to ISI specification and further work to find out economic feasibility is being carried out.

(e) Phospho-gypsum

Investigations on making white high strength phospho-cement utilizing by-product gypsum were undertaken. Thermal studies were carried out to determine the temperature of mineralization. Parameters like temperature, optimum time of soaking, nature and amount of additives for complexing the colouring agent (*i.e.* iron) were standardized. The end-product showed marked improvement in colour and compression strength.

07 RC 02 Boron Based Chemicals

(i) *Sodium perborate tetrahydrate* : A process has been developed to synthesize this compound by a continuous way. All the parameters for its synthesis upto 1 kg batch have been standardized. The yield of the compound is more than 85%. Its monohydrate and anhydrous forms were also prepared. Its anhydrous form was found to be unstable whereas mono-and tetrahydrates were quite stable. There was a negligible loss of available oxygen even after prolonged storing.

(ii) *Ammonium pentaborate tetrahydrate* : This compound was prepared on laboratory scale. Process for its synthesis is being developed. Upon storing this compound for a longer duration, loss of ammonia was observed.

(iii) *Barium metaborate* : A process has been developed to prepare this compound on laboratory scale. Its tetra and dihydrate forms were prepared. X-ray analysis of this compound showed it to be amorphous compound. Work is being continued to crystallize this compound. Yield obtained is always less than 50%. Work was also carried to convert this tetrahydrate/dihydrate to monohydrate/anhydrous compound by thermal treatment. But success was achieved only in obtaining anhydrous compound.

09 RC 01 Chemical Compounds for Enhancing Silk Productivity in Field Races of Silkworm *Bombyx mori* L.

Various extracts of the plant No. 034 were prepared and the LD_{50} studies were carried out and found to be 2.5 mg/kg (i.p.). 50% alcoholic extract was fractionated into choloroform, ethyl ecetate and butanol fractions. The stability studies of the fractions are being carried out. The butanol fraction was separated into CTB I,CTB II and CTB III. A mixture of CTB I, CTB II & CTB III in a ratio of 0.03:2:5 was applied topically on 5th stage larvae of silkworm (*Bombyx mori*) (race RL 26) at 48 hrs after last moult @50 µg compound mixture dissolved in 20 µl of water per larva. Along with this crude extract of Plant No.034 @ 50 µg/larva in 20 µl alcohol and a water control @ 20 µl/larva was also run. Two hours reduction in larval duration was observed due to both treatments. The results summarized in Table 16 indicate that application of both crude extract and the mixture of CTB I, CTB II & CTB III, significantly increased average cocoon weight and shell weight by 14.4 and 10.15%, respectively over control. It is clear that crude extract shows higher activity than the mixture of pure compounds isolated from the extract.

Table 16 : Effect of Crude Extract Plant Number and Mixture of CTB I, CTB II & CTB III on Silk Productivity

Treatment	Dose per larva	No. of cocoons harvested	Av. Cocoon weight (g)	Av. Shell weight (g)	Shell %	% increase silk over control
Mixture of CTB I, CTB II & CTB III (0.03:2:5)	50 µg in 20 µl H_2O	47	1.15	0.15	13.2	10.15
Crude Extract	50 µg in 20 µl alcohol	46	1.13	0.16	13.0	14.4
Control	20 µl H_2O	46	0.96	0.14	14.4	—

50 larvae treated in each treatment group.

09 RC 02 Development of Artificial Feed for Silkworm (*Bombyx mori* L.)

Yellow corn flour, a cheap source of starch, oil and sterols was used in a semi-synthetic diet formulation. Control diet consisting of soluble starch, soyabean oil and β-sitosterol and test diet control containing 20% yellow

corn flour were prepared and tested for rearing newly hatched silkworm larvae.

It was observed that survival rate of larvae reared on test (corn) diet was better than those reared on control diet. Larvae reared on test diet took lesser time to reach I, II and III moult stage as compared to control diet (Table 17). Moulting was less erratic in the larvae reared on test diet as compared to control diet. Results indicate that yellow corn powder can not only successfully replace soluble starch, soyabean oil and ß- sitosterol in artificial diet but also improves survival and growth rate of larvae. Use of yellow corn powder can reduce the cost of diet by 8-10%.

Table 17 : Survival (a) and Growth Rate (b) of Silkworm Larvae Reared on Control and Test Diet

Diet	*(a) % Survival of larvae at Moult*		
	I	*II*	*III*
Control Diet	43	29	—
Test (Corn) Diet	80	51	31
	(b) Time in days to reach Moult		
	I	*II*	*III*
Control Diet	4-8	15-16	—
Test (Corn) Diet	3-6	10-13	17-20

10 INSECT PHYSIOLOGY

10 RC 01 Physiology of Insect Reproduction

(a) Structure of *Callosobruchus chinensis* egg : effect and mode of action of vegetable oils

Elaborate light and scanning electron microscopical studies of *C. chinensis* egg were conducted with the aim of finding out as to why the application of vegetable oils on pulses lowers down the incidence of bruchid infestation. The studies revealed that the egg of this insect is tortoise- shell shaped *i.e.* the dorsal convex surface is thick and hard while the ventral surface, which is in contact with the grain, is thin and acting as a respiratory surface. This ventral surface is comprised of stub like tubercles from outside near the tapering posterior micropylar end of the egg, and a zone of small projections that starts behind the tubercles and continues upto the round anterior end. The aeropylar openings too are situated ventrally near the micropyle. Also, there is a delicate network spread along the ventral surface. All the structures of the ventral surface assist the egg to maintain some distance from the seed coat on which it is adhered so that the flow of air for breathing purposes remains uninterrupted.

The respiratory function of the ventral side was proved in experiments of sealing the egg by wax at different regions. Blocking at the micropylar end

resulted in embryonic deaths thereby showing the importance of this region because wax-barrier hindered the inflow of air to the aeropyles situated near the micropyle.

In another set of experiments, vegetable oil application brought about embryonic deaths in a manner similar to that of wax-blocking. Therefore the oil causes depletion of moisture by penetrating the lipoidal (waxy) layer of the egg which disrupts the water conservation capacity leading to desiccation and a simultaneous deprivation of the dissolved oxygen results in anoxia (or respiratory blockade). The study emphasized the fact that the vegetable oils are not toxicants but physical ovicides causing embryonic deaths due to water imbalance and respiratory failure.

(b) Testing of the compounds

(i) *Conessine* : The compound was given to the last larval instars of two stored grain pests *viz. Tribolium castaneum* and *Corcyra cephalonica* in concentrations ranging between 0.001 to 0.2%. There was almost no effect on the adult formation and the fecundity and fertility of the emerged adults.

(ii) *Vateria oil* : The oil (provided by NPC Division) was tested for biological activity on the male and female adults of *Dysdercus koenigii* in 1% concentration (2 and 5 µl dose topically) but no significant effect was found.

(iii) *LS-RS* : This compound (provided by Cellulose and Pulp Division) was tested for antifeedant activity against larvae of *Pieris brassicae* in concentrations of 0.01% and 0.1% and against the 5th instars of *D. koenigii* at 100 ppm dose. There was not much effect in comparison with the controls.

11 UTILIZATION OF CELLULOSICS

11 RC 01 Utilization of Lignocellulosic Materials

(a) Medium density fibreboard (MDF)

(i) Studies on MDF from '*Sarkanda*' grass were carried out. Pulping of the material was done by (i) hydrothermal (ii) cold soda semi-chemical, and, (iii) soda semichemical methods. MDF were made by wet process. Water soluble PF resin prepared in the laboratory was used in different proportions to increase the bond between the fibres. Test results of some of the MDF are given in Table 18.

Table 18 : MDF made from Sarkanda by Different Pulping Methods

Pulping method	Resin (%)	Board density ($g\ cm^3$)	MOR ($kg\ cm^2$), (%)	WA 2h
Hydrothermal	C	0.92	237	120
	5.0	0.85	231	112
Cold soda	C	0.87	322	109
Semi-chemical	5.0	0.82	201	88
Semi-chemical	C	0.92	303	100
	5.0	0.89	314	72

C = Control MOR = Modulus of rupture WA = Water absorption

(ii) *Large scale processing of lignocellulose for MDF :* Large scale pulping was carried out on cotton stalks by hydrothermal process. The pulp was studied for MDF both on laboratory and pilot scale using urea formaldehyde resin and wax emulsion as binder and water repellent respectively. Dry fiberised pulp was also prepared from cotton stalks (12 kg), poplar (7.5 kg) and eucalyptus (5.0 kg) by hydrothermal process and supplied to M/s Nu Chem Agro-Products for further R&D studies. Test results of some MDF made out of the hydrothermal pulp by dry process with UF resin and wax emulsion are given in Table 19.

Table 19 : MDF Made out of the Hydrothermal Pulp

Material (g/cm^3)	Board (kg/cm^2)	density (kg/cm^2)	MOR %)	IB WA 24h
Cotton	0.73	240	8.0	6.0
Eucalyptus	0.78	167	7.2	5.8
Arhar	0.77	—	11.2	11.2

IB = Internal Bond

(iii) *Studies on arhar (Cajanus cajan) stalks :* Chemical analysis of arhar stalks indicated holocellulose 63.3%, cellulose C&B 47.7%, lignin 26.5%, pentosans 25.4%, 1% NaOH solubles 36.5%, hot water solubles 15.6% and cold water solubles 12.1%. The material was pulped by hydrothermal process and converted to MDF by wet process using PF resin and wax emulsion. Particle boards were also made from arhar stalks with varying amounts of UF and PF resins. Test results indicated ISI requirements with respect to density, MOR and IB.

(b) Composite and hybrid composite boards

Jute cloth, paper board and glass tissue sheets were laminated with PF resin (water soluble PF prepared in the laboratory) as matrix.Combination of jute cloth and glass tissue gave the highest MOR.

(c) Pulping studies by organo-solv process of 'Sarkanda' grass

Pulping was carried out with aq. methanol, ethanol and butanol at 120°C in an alkaline medium. In each solvent the concentration of alkali was varied. Pulps were analyzed for Kappa number and converted to standard paper sheets for evaluation of strength properties of paper.

(d) Improvement of MOR of banana fibre soft boards

Banana fibre soft boards made by hand made process have poor MOR. Further improvement of banana fibre boards was carried out at the request of Centre of Science for Villages, Wardha. The boards were given a hot

compression and in some cases were coated with UF resin prior to compression. The boards after treatment showed marked improvement in MOR.

(e) Lignosulphonates from non-wood lignin

Work on optimization of parameters for sulphonation of 'Sarkanda' lignin was carried out. Lignin was isolated from commercial black liquor (obtained from paper plant) by HCl and HNO_3. It was subsequently sulphonated by sulphur dioxide and sodium bisulphite. The sulphonated lignin compared well with the commercial imported lignosulphonate with respect to *p*H, viscosity, solubility, IR and UV spectra.

(f) Utilization of tea waste

Tea waste was extracted by different solvents to isolate biopolymers such as polysaccharides, polyphenols and proteins. Number of fractions from the extracts were also prepared and were evaluated for biological activity. Extractive free tea waste after chemical analysis for cellulose, lignin and pentosans was studied for pulping for fibreboards and straw boards. In some cases the pulp was blended with waste paper pulp to increase the strength. Fibreboards from tea waste recorded MOR 182-275 kg/cm^2 and straw boards gave breaking length 1062-1080 m and after blending with waste paper to the extent of 50%, the breaking length increased to 1205-1305 m.

IN-HOUSE R&D PROJECTS, LABORATORY INVESTIGATIONS, NATIONAL MISSION PROJECTS, THRUST AREA AND EXTERNALLY FUNDED PROJECTS

IN-HOUSE R&D PROJECTS

02 IH 05 Development and Standardisation of Vegetative Propagation Techniques (Budding and Grafting) for Walnut (*Juglans regia* L.)

Development of root stocks

Efforts were made to standardize vegetative propagation techniques and cultivate grafted seedlings for production of quality walnuts. To start with development of root stocks of proper thickness for raising grafted plants was initiated and seed collected from six different sources was sown in the Laboratory farm at Sanat Nagar, Srinagar. In addition to seedling root stocks, clonal root stock development was also initiated. 200 stem cuttings of walnut were procured and planted in the nursery for raising genetically uniform root stocks.

03 1H 01 Isolation and Characterization of Biologically Active Compounds from Medicinally Important Plants

(i) Fraction RLJ-NE-023 obtained from crude extract of plant No. 002 showed 100% abortifacient activity at a dose of 400 mg/kg. Detailed general pharmacology of this fraction along with fraction Nos. RLJ-NE-022 and 024 obtained from same plant at a dose of 100 mg/kg and 250 mg/kg p.o. revealed that Fr. 023 at these doses possesses diuretic activity 50% and 70% respectively; Fr. 022 and 024 displayed weak antiinflammatory activity *i.e.* 11-24% and 21-26% respectively in rats at 200 mg/kg . Fr. 023 produced mild C.N.S. depressant effect in mice at 100 and 200 mg/kg.

Further, subfractions of RLJ-NE-023 *viz.* RLJ-NE-411, 412, 413 and 417 showed 60% (300 mg/kg), O% (300 mg/kg), 33.3% (150 mg/kg), and 33.3% (300 mg/kg) abortifacient activity respectively.

From the fraction Nos. 022 and 023 atleast ten pure sub- fractions could be isolated. Out of them two have been characterized as long chain aliphatic-N-isobutyl amides (*viz.* dodecadienoic and tetra decadienoic acid n-isobutyl amides) apart from ß amyrin, ß sitosterol, stearic acid, two glycerides and an inorganic residue (Ca, 8.4%; Na, 0.1%; K, 0.05%; Cl, 0.79% with traces of PO_4 and SO_4).

(ii) Reinvestigation of an amide isolated from plant No. 050 followed by chemical degradation studies resulted in its characterization of a new compound namely 4-hydroxyphenyl ethyl-isoferulic amide. Further studies of plant No.047 and 048 lead to revision of previously isolated compounds along with isolation of aliphatic compounds. From fraction No. RLJ-NE-134 three aliphatic compounds were isolated which did not show any marked abortifacient activity.

(iii) Fraction No. RLJ-NE-513 obtained from Plant No 078 showed 80% antiimplantation activity (dose : 200 mg/kg).

08 IH 01 Development of Backward Areas

(a) Culture of Scephalebris kingi

Manures like cow dung, goat manure, poultry droppings and pig manure were tried for culture of S. *kingi* (a fish food organism) in the laboratory. Solution containing each manure @ 1 gm/L was added in each 500 ml beaker having *p*H 7.5±0.5 and kept on 20±1°C. 10 Nos. of parthenogenic females were added in each beaker and observations recorded after every 48 hrs. After 12 days of rearing, maximum population was observed in goat manure (240/lit.), followed by cow dung (90/lit.), pig manure (64/lit.) and poultry droppings (58/lit).

(b) Effect of agricultural fertilizers on fish blood

The effect of sublethal concentration of muriate of potash (400 mg/L) on blood of *Cyprinus carpio* was studied. The male fishes with 240 mm to 272 mm length were selected for the study. The fishes were exposed to the fertilizer for a period of 30 days and the observations recorded after every week. The parameters like Hb concentration, RBC and WBC count, ESR, PCV, CT, blood sugar, blood urea, blood protein and serum cholesterol were recorded. The observations showed decrease in RBC and Hb concentrations with increase in exposure period. The biochemical parameters like blood sugar and blood urea showed increasing trend whereas blood protein and serum cholesterol decreased with increase in exposure period.

(c) Effect of varied temperature on Daphnia similis

One parthenogenic female of laboratory stock culture of *D. similis* was kept in each 100 ml beaker with 50 ml of sieved pond water at three different temperatures *i.e.* 10±1°C, 16±1°C and 22±1°C. Hatching was 68%, 90% and 60% respectively. 20 young ones each were reared at above temperature. The results showed that the maturation begins at 18 days at 10°C, 12 days at 16°C and 10 days at 22°C with mortality of 20%, 5% and 10% respectively.

(d) Effect of agricultural fertilizers on the spawn of Cyprinus carpio

One day old spawn of *Cyprinus carpio* at 30±1°C were exposed to different concentrations of diammonium phosphate (DAP) and muriate of potash (MOP). Mortality of spawn was checked after 24, 48 and 72 hrs. of treatment.

After 24 hr. treatment with DAP 20% mortality was observed at 70 mg/L, 10% at 30 mg/L and 100% at 100 mg/L after 48 hr. However, after 72 hr. 10% mortality was recorded at 20 mg/L and 100% at 80 mg/L of concentration. In case of MOP 10% mortality was observed at 500 mg/L and 400 mg/L and 100% at 900 mg/L and 800 mg/L after 24 and 48 hrs. of treatment respectively. Whereas after 72 hr. of treatment 10% mortality was recorded at 200 mg/L and 100% at 700 mg/L.

(e) Bacteriological studies

Seasonal quantitative and qualitative studies of bacteria inhabiting RRL pond from surface water and benthos has been worked out for one year. The counting of aerobic and facultative bacteria was done by standard plate count method. The samples after collection were brought to the laboratory immediately and streaked on starch agar plate after 1:10 and 1:100 dilutions. SPC of RRL pond ranges from 174 to 540 colonies/ml with minimum in April and maximum in September.

The bacterial species, *Bacillus megaterium, B. cereus, B. subtilis, Micrococus luteus, M. roseus, Sarcina lutea* were recorded from the surface water samples almost throughout the year and *Aeromonas hydrophila, A. caviae, Bacillus sphaericus* were rarely present. In benthic fauna the dominant species recorded were *Bacillus sphaericus,B.subtilis, B.megaterum* and *Sarcina lutea* throughout the year and *Aeromonas hydrophila* and *Arthobacter* sp. were rarely observed in the samples.

LABORATORY INVESTIGATIONS

I. Flora of the Upper Liddar Valleys of the Kashmir Himalaya

Systematic evaluation of Upper Liddar Valleys flora resulted in establishing the identity of nine genera comprising of twenty five taxa under the six families listed below :

Family *Amaranthaceae*

(i) *Amaranthus hybridus* Linn. ssp. *cruentus* (Linn.) Thell.

(ii) *A. hybridus* Linn. ssp. *cruentus* Thell. var. *paniculatus* (Linn.) Thell. (syn. *A. paniculatus* Linn.)

(iii) *A. lividus* Linn. (syn. *A. blitum* Linn.)

Family *Chenopodiaceae*

*(iv) *Acroglochin persicarioides* (Poir.) Moq. (syn. *A. chenopodioides* Schrad.).

(v) *Chenopodium album* Linn.

(vi) *C. botrys* Linn.

*(vii) *C. foliosum* Aschers.

(viii) *C. hybridum* Linn.

Family *Gentianaceae*

(ix) *Gentiana argentea* DC.

*(x) *G. cachemirica* Decne. (Syn. *G. loderi* Hk. f.)

(xi) *G. capitata* Buch.-Ham.

(xii) *G. clarkei* Kusn. var. *acuminata* Kusn. (syn. *G. pygmaea* (Cl) var *acuminata* (Cl.)

(xiii) *G. kurrooa* Royle

(xiv) *G. marginata* Griseb (syn. *G. carinata* Griseb. var. *marginata* (Cl.)

(xv) *G. tianschanica* Rupr. ex Kusn. (syn. *G. decumbens* Cl)

(xvi) *G. venusta* Griseb.

*(xvii) *Gentianella moorcroftiana* Airy Show (syn. *Gentianella moorcroftiana* Wall. ex G. Don)

(xviii) *Gentianella pedunculata* H. Smith (syn. *Gentiana tenella* Cl.)

*(xviv) *Gentianopsis stracheyi* Holub. (syn. *Gentiana detonsa* Cl. var. *stracheyi* Cl.)

(xx) *Jaeschkea canaliculata* Knobl. (syn. *J. latisepala* Cl.)

(xxi) *J. oligosperma* Knoble (syn. *J. genetianoides) Kurz.*

Family *Oleaceae*

*(xxii) *Syringa emodi* Wall. ex Royle.

Family *Primulaceae*

(xxiii) *Androsace muscoidea* Duby.

(xxiv) *A. sempervivoides* Jacq.

(xxiv) *A. studiosorum* Kress.

(syn. *A. primuloides* Duby syn. *A. sarmentosa* Roxb. var *primuloides*

All the above 25 taxa have been described in detail and their examined voucher specimens cited under their respective descriptions with notes on the frequency of their occurrence, their habitats and flowering and the fruiting periods. Taxonomic keys at both generic and specific levels have been devised. Eight of the taxa marked with an asterik(*) in the above list have been illustrated in full size line drawings intended as additional aids to their identification. An unidentified Fabaceae collected from Jammu was determined to be *Crotalaria sessiliflora* Linn. ssp. *hazarensis* Ali. The taxon was duly described and communicated for publication as a new record for the Jammu and Kashmir State.

II. Introduction of Selected Species of Economic Importance in Kashmir Valley

Asparagus

Cultural practices : The data collected from agronomical trial comparing the effect of different combinations of soil, sand and farm yard manure on spear production was consolidated and results analysed statistically. Soil amended with sand and farm yard manure in different ratio gave more yield than the control. The difference in weight of spears was significant when compared with other characters. The highest yield of marketable spears was produced in the soil amended with equal amount of sand and farm yard manure.

Extension : Some new areas of Jammu Province and Himachal Pradesh were identified and found suitable for asparagus cultivation. Six kilograms of improved asparagus seed of strain SL-831 was supplied to various growers in Jammu province and Kasauli in Himachal Pradesh for cultivation. Regular technical guidance was made available to various entrepreneurs.

III. Cultivation and Physiology of Ashwagandha [*Withania somnifera* (L.) Dunal]

Germ plasm was collected from a number of places in India *viz.* Doda & Kishtwar (J&K), U. P., Bhopal and other areas of M.P., Delhi and suburbs of Jammu. 15 types of this plant are being grown in experimental plots and their performance observed. Seed germination was found to be low in this species. Effect of sowing dates and age on seed germination was studied

both in wild as well as cultivated types. A perusal of the data presented in Tables 20 and 21 shows that optimum period of seed sowing in *Withania somnifera* under Jammu conditions is mid-July to early August. Seeds do not require rest for a long period. One month, three months and six months old seeds show similar pattern of germination, but viability is considerably decreased in one year old seeds. The variation in germination was mainly due to type differences rather than age. Cultivated type 024 gave maximum germination in all the sowings.

Table 20 : Effect of Age on *Seed Germination (%) in types of *Withania somnifera*
(Period of Sowing, July, 1991)

Type	Age			
	One month	3 months	6 month	1 year
0.24	57	55	62	13
WSL-2	35	40	43	10
012	43	49	53	7
025	25	35	33	—
027	33	32	28	—

* Mean of 3 replicates

Table 21 : Effect of Different Sowing Dates on *Germination Potential of *Withania somnifera* (L.) Dunal

Types	Sowing dates	Year 1991 (% Germination)		
	15 March	15 June	12 July	6 August
010 Doda	28±1.5	50±2.8	56±0.57	33±0.57
WSL 2(Local)	26±1.22	28±0.91	40±3.2	35±2.8
025 (Bhopal)	—	16±2.3	35±0.40	25±1.1
027 (Delhi)	—	20±2.8	32±1.5	20±1.5
024 (M.P.)	31±1.5	18±0.91	64±1.8	53±0.40

* Mean of 3 replicates

At seedling stage "damping off" was found to be a serious disease. A number of fungicides were tried initially for control of damping off. Dithane M-45 was found to be superior. Hence, effect of different modes and concentrations of Dithane M-45 was studied on seed germination and seedling growth in detail. Results showed that 0.5% concentration of Dithane was optimum both as regards germination and survival % in seedlings. Higher doses, *i.e.* 1 & 1.5% though controlled damping off yet were found detrimental to further growth of seedlings. Seed soak treatment combined with soil disinfection was found superior over other methods of Dithane application.

IV. Cymbopogon species

(a) TAB Project on commercial exploitation of Cymbopogon species

(i) *Citral rich varieties* : Three varieties rich in citral content namely CKP-25, Pragati and Jorlab L_2 developed by RRL- Jammu, CIMAP-Lucknow and RRL-Jorhat respectively were evaluated for their herbage and oil yield and oil quality. Five cuttings were obtained from CKP-25 variety whereas Pragati and Jorlab L_2 gave only four cuttings during the year. Variety CKP-25 outyielded other two varieties in terms of herbage, oil yield, oil content and citral content.

(ii) *Geraniol rich varieties* : Comparative performance of two geraniol rich varieties namely PRC-1(Palmarosa) developed by CIMAP-Lucknow and Jamrosa (RRL-82) by RRL, Jammu was studied. Under the climatic conditions prevailing at Jammu PRC-1 (Palmarosa) gave only three harvests whereas Jamrosa gave five cuttings during the year. The herbage, oil yield and oil content were higher in Jamrosa whereas the geraniol content was found to be higher in Palmarosa variety.

(b) Multi-location Trials

Under multi-location trials, the new variety of Lemongrass CKP-25 is being cultivated successfully in about 3 hectares located in the States of J&K, Punjab and Uttar Pradesh. The oil and citral content as well as oil yield per hectare has been found to be at par with plantation at our experimental farm at Jammu. Zinc deficiency was observed in the plantation at Hoshiarpur (Punjab) which was corrected by spraying of 0.2% zinc sulphate solution. The farmers were trained for the multiplication techniques to expand their crops in newer areas. The crop of the nearby farmers, who undertook these trials was distilled and the distillation process was demonstrated to them.

Utilization of Minerals

(a) Precipitated $CaCO_3$ and basic $MgCO_3$

Samples of Vaishno Devi dolostone were collected and since bands of light and dark colour are commonly encountered in them, a portion representing each of these bands was taken up for chemical analysis and microscopic studies with a view to understand the cause behind light and dark shades. Bands rich in silica in the form of crypto crystalline to microcrystalline quartz are generally light in colour but at the same time it has also been observed that light bands are there even without much silica. The colour of magnesite of Panthal (Katra) in Jammu is brownish grey to brownish white but some samples contain darker portions among them. The latter generally contain more of MgO and Fe_2O_3 than the former ones which is contrary to the apparent feeling that dark portions represent the unconverted dolomite.

Further experiments were conducted on the manufacture of precipitated $CaCO_3$ and basic $MgCO_3$ and a report in this regard was sent to the Department of Science and Technology, Government of India, New Delhi.

The studies have revealed that there are many limestone deposits of M.P. which can give a precipitated calcium carbonate comparable to Ponta Sahib precipitated calcium carbonate. The precipitated calcium carbonate from Jammu and Kashmir limestone was treated with various chemicals to improve its whiteness.

(b) Growth of gibbsite

Aluminium hydroxide was precipitated as gelatinous precipitate by adding ammonia to the concentrated solution of aluminium sulphate. The precipitate was filtered and washed with excess of water. The gel so obtained was kept for ageing in the solution for different lengths of time (48 hours, 5 days, 10 days, 25 days, 50 days, 100 days, 200 days and 340 days) at room temperature. After each interval the gel was filtered, dried and then studied by X-ray diffraction analysis. The analysis revealed that initially gibbsite grows in the form of amorphous structure and with the increase of ageing period well developed interplaner spacings of gibbsite structure appear. It has also been observed that bayerite structure appears only upto 10 days ageing and after that the crystallinity of only gibbsite structure increases.

(c) Granites, sandstones and others

Hills of J&K State are full of sandstone shals, schists, gneisses, traps, agglomeratic slates, quartzite, limestone and dolomitic limestone. A project report entitled, "Manufacture of Blocks, Slabs and Tiles from Jammu Sandstone, Granites and other rocks together with the cost estimates", was submitted to the Department of Science and Technology, Government of Jammu and Kashmir.

VI. Investigations Done at RRL Extension Centre, Palampur

Besides rutin bearing *Eucalyptus* which has already proved success at Palampur the following are at various stages of expermentation for their cultivation and utilization.

Humulus lupulus : In all 30 accessions have been introduced in our germplasm bank of hop at Palampur. The results obtained during the year are given in Table 22.

Panax pseudoginseng : Rhizomes which were brought from N.E. India, were planted at Palampur. The plants started appearing when the maximum and minimum temperature was between 11°C to 22°C under diffused light.

Other plants : *Helianthus tuberosus, Tagetes erecta, Dipsacus fullonum* are also being cultivated.

Table 22 : Chemical Analysis of 23 Hops Introductions

Entry	α-acids	β-acids	oil %
1	7.40	4.40	0.06
2	3.00	9.00	0.85
3	7.40	3.70	0.16
5	8.50	5.50	0.20
6	4.80	1.80	0.04
8	9.00	4.50	—
9	3.30	2.60	0.70
10	12.50	4.80	1.70
11	8.40	4.40	0.53
12	6.50	4.40	0.37
13	11.00	3.60	0.33
15	14.30	6.40	0.23
PL 208	13.10	4.70	—
H-2	5.10	3.10	—
PL-246	8.90	7.60	—
Shimshu	8.00	6.00	—
PL-320	10.60	5.00	—
PL-176	1.57	0.84	—
PL-306	6.40	6.60	—
Golden Cluster	8.60	3.00	—

VII. Electron Microscopic Work Done for Other Divisions by Insect Physiology Section

(i) Scanning and photography of nine samples of stigmas of saffron, dried at different set ups and temperatures (provided by NPC Division) was conducted. Bulbous scent glands present on the surface of stigmas showed a variability in their numbers and preservation depending upon the condition of their drying. The flavour of saffron depends upon the intact conditions of the scent glands.

(ii) Embryoids of saffron (provided by Botany Division) were studied by scanning electron microscopy. It was seen that in initial stages (*i.e.* in globular embryoids) the outer surface has round thin-walled cells but with advancement of embryogenesis, such cells rupture and an inner core of parenchymatous cells is formed which can be seen in exposed form.

(iii) Scanning electron microscopy was conducted on the peritonial cells provided by the Pharmacology Section.

(iv) Samples of the control and piperine treated rat intestine (treated separately for 30 min.,60 min. and 90 min.), provided by Pharmacology

Division were processed for transmission electron microscopy. The control and 30 min. pipeline treated material was cut for ultra thin sections and relevant areas photographed. A marked change in the treated samples was noticed in the size of the microvilli and in the appearance of mitochondria.

(v) Six samples of the bacteria infecting fishes (Rural Technology Unit) were scanned under the SEM system.

MISSION PROJECTS

(a) National Literacy Mission

Under this Mission our Laboratory was expected to develop one of the techno-pedagogic input (Improved gypsum chalks *i.e.* Dustless) and to train the master trainers for its production throughout India. Both the jobs have been successfully completed. Boards specific chalk formulations, production process and methods of evaluation of chalks to meet the specifications specified by us were developed and master trainers from throughout India were trained. Video films in Hindi and English were prepared which demonstrated the production method and the quality control. Booklets giving all the production details and practical work book entitled, "Learning Record" were prepared in English as well as in Hindi for the benefit and record of the trainees. Four comprehensive training programmes were organized at different stations in India wherein the participants from Orissa, Bihar, Bengal, Assam, Gujarat, Maharastra, Rajasthan, Haryana, Uttar Pradesh and Jammu and Kashmir were trained. The participants brought their locally available material which was assessed by us and by the participants for its use for the manufacture of chalks of the specification recommended by us. In the training programme chalks available at various places in India were also assessed. The participants after getting fully trained in production and quality control were asked to work out the economic viability of the project. Thus they were equipped with a project report for submission to different authorities for funding purposes.

(b) National Water Mission

(i) *Training* :"Water Quality and Surveillance" Training Programme organized in collaboration with ITRC, Lucknow, from 20 to 27 May 1991 and about 20 PH Engineers from Jammu took part in this training.

(ii) *Water Quality Assessment*: Assessment of water quality of 3 districts of Jammu (Rajouri, Doda and Jammu) was taken up with ITRC in two phases (8.10.1991 to 3.11.1991 and 3 to 31 December, 1991).

THRUST AREA - 18

Fertility Management

(a) Anti-implantation studies

The following compounds were tested for anti-implantation activity on day 1 of pregnancy in rats. Laparotomy was performed on day 10 of pregnancy to record number of implants. The results are summarized in Table 23.

Table 23 : Anti-implantation Activity of Test Compounds

Compound	Route	Dose (mg/kg)	Inhibitory activity (%)	Number of implants Mean ±S.E.		No. of animals
Vehicle		0.0	7.8	8.80	0.35	51
RS 1	I.P.	0.2	33.3	2.25	0.95	6
		0.4	100.0	—	—	5
	I.M.	0.2	25.0	4.33	0.88	4
		0.4	100.0	—	—	5
	S.C.	0.4	71.0	4.50	2.50	7
K-7	I.P	0.1	60.0	3.50	0.50	5
		0.2	100.0	—	—	5
		0.2	100.0	—	—	6
	S.C.	0.2	40.0	8.66	0.33	5
		0.5	100.0	—	—	6
K-8	I.P.	0.2	0.0	7.60	1.28	8
		1.0	75.0	2.0	—	4
		1.5	80.0	1.00	—	5
		2.0	100.0	—	—	6
	I.M.	2.0	100.0	—	—	5

(Contd.)

K-14	P.O.	1.0	62.5	1.00	0.00	8
	I.P.	1.0	100.0	—	—	5
		0.5	100.0	—	—	6
	I.M.	1.0	40.0	11.0	2.43	5
		2.0	28.6	9.0	1.81	7
		4.0	100.0	—	—	5
RLJ-SY-292	P.O.	1.0	100.0	—	—	8
		0.5	100.0	—	—	6
		0.25	30.0	4.86	0.93	10
RLJ-SY-325	P.O.	1.0	0.0	9.60	1.80	5
		2.0	0.0	8.80	0.37	5
RLJ-SY-327	P.O.	1.0	0.0	9.60	0.93	5
		2.0	0.0	9.28	0.71	7
RLJ-SY-336	P.O.	1.0	100.0	—	—	6
		0.5	90.0	1.00	0.00	10
		0.25	90.0	1.00	0.00	9
RLJ-SY-340	P.O.	1.0	100.0	—	0.00	8
		0.5	90.0	1.00	0.00	9
		0.25	30.0	7.37	1.00	11

EXTERNALLY FUNDED PROJECTS

Demonstration and Development of Bio-fertilizer Based on Rhizobium sps. for various Cultivars of Phaseoli (Sponsored by the Department of Biotechnology, Government of India, New Delhi)

As a part of DBT-sponsored short and long term national project on the development of bio-fertilizers, fermentation studies at bench and pilot scale bioreactors were conducted. An economical medium composition comprised of molasses and cornsteep-liquor (CSL) as carbon and nitrogen sources respectively was standardised for the optimum cultivation of *Rhizobium* sps. Of the various carriers tested, lignite (200 mesh) was found to stably sustain the viability of the organism for a period of three months when stored at 30^0C. The limited field trials for studies on nodulation efficiency on various cultivars of *Phaseolus vulgaris* commonly grown in the region have been conducted. In Fig. 3 the nodulation pattern on French Bean are shown.

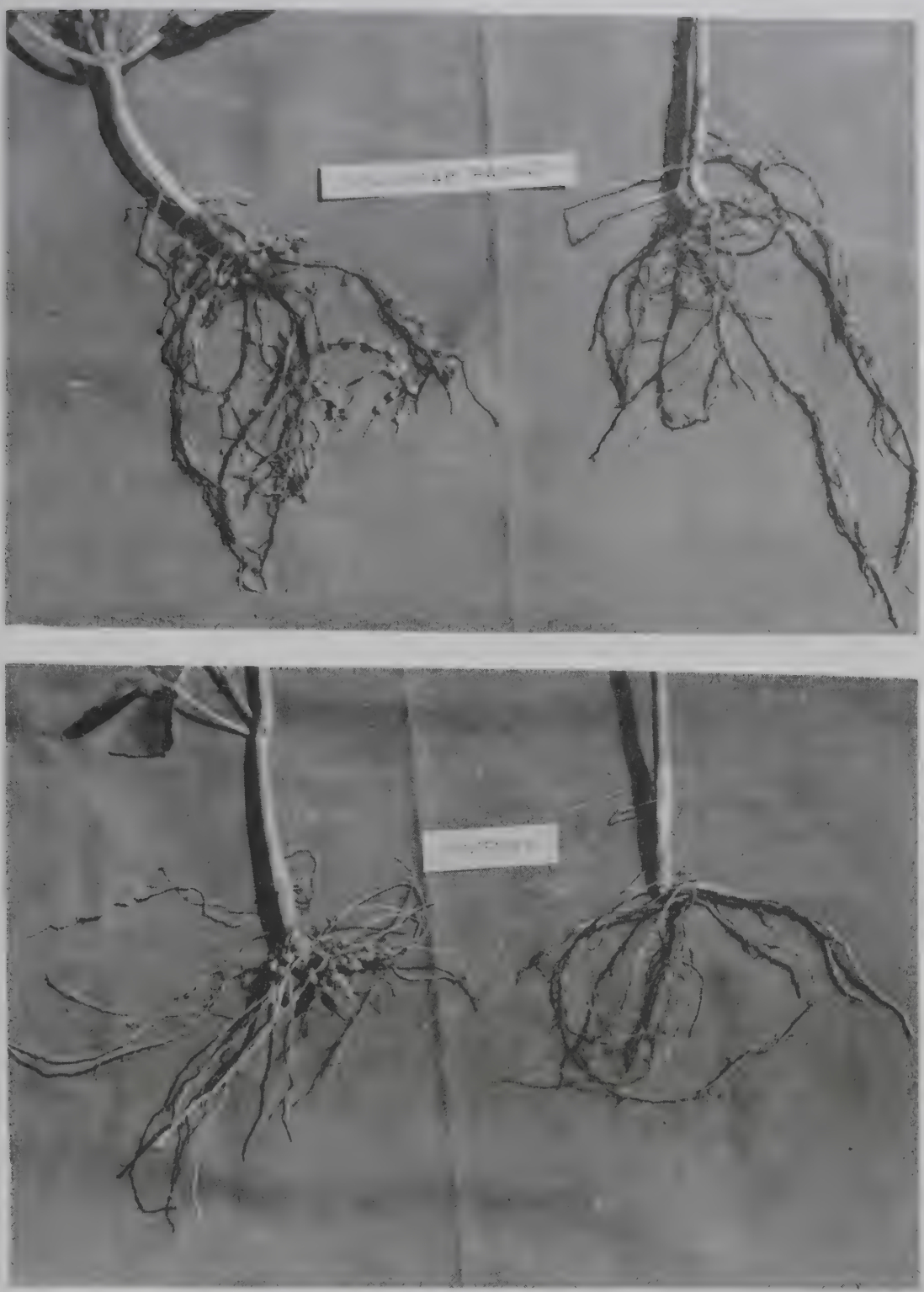

Fig. 3 — Nodulation Pattern of Bhadarwahi Rajmash and French Bean var. Contender Treated with Rhizobium (FB.77) in Comparison with Control (Right Side).

All India Co-ordinated Research Project on Ethnobiology Phase- II (Sponsored by the Department of Environment, Government of India, New Delhi)

Ethnobotanical investigations were conducted in Garhwal (UP) and Rohtang (HP). Twenty-five medicinal and four edible plants commonly used were recorded. The pressed specimens were mounted on the Herbarium sheets. Data was compiled for final technical report to be submitted to the Ministry of Environment and Forests Government of India.

Domestication and Multiplication of Bunium persicum (Kala Zira). (Sponsored by J&K Forest Department)

Planting material was supplied to the Forest Department for plantation purposes at various places in J&K (Srinagar, Ramban, Banihal,Patnitop,Batote, Kishtwar, Bhadarwah etc.). Germplasm has also been planted at Patnitop for studying various parameters regarding agrotechnology. About 7 kg. dry seed of Kala Zira has been collected from the experimental station Atholi and Kishtwar.

Utilization of Geothermal Energy

(a) Sponsored by the Central Electricity Authority, Ministry of Energy, Government of India, New Delhi

Corrosion studies of various metals in geothermal environment of Puga were conducted. The trough to be used for hot water and also for steam has been designed and fabrication is in progress. The data on corrosion being generated is required by funding agency for finalizing the metals to be used in fabrication of turbine for generation of electricity using Puga s geothermal energy.

(b) Sponsored by the Department of Non-Conventional Energy Sources, Government of India, New Delhi

For utilization of this non conventional energy for Poultry and Mushroom Production the fabrication of huts is being taken up. The cause of chocked geothermal wells at Puga was also studied.

Effect of HP-1 on Experimentally Produced Toxicity (Sponsored by M s Hind Chemicals, Kanpur)

Effect of HP-1 on experimentally produced toxicity due to (i) CCl_4, (ii) paracetamol, and (iii) monocrotaline was investigated. The parameters investigated were; (a) lipid peroxidation, (b) enzyme activities : SOD and catalase, and (c) levels of GSH in the rat liver. The results have shown that oral administration of HP-1 (100 and 200 mg/kg) produced significant altera-

tions in the biochemical parameters which could be correlated with its free radical scavenging action. The ability of HP-1 to reverse the toxic biochemical manifestations produced by the above mentioned toxic agents could also be demonstrated.

CO-ORDINATED PROJECT

Bioreactor Design and Pressure Fermentation (between RRL, Jammu and T.C.B., University of Dortmund, Germany)

In aerobic fermentation processes availability of dissolved oxygen in optimum concentrations is a critical factor that determines the capability of employed microorganisms. The influence of dissolved oxygen in static or dynamic state on the overall process in turn determines the selection of a reactor type.

Preliminary studies conducted at TCB, (Dortmund) on *Pseudomonas*, *Glucono-bacter*, and *Methylomonas* sps. had revealed negative influence of high oxygen partial pressure on growth of these bacteria. At the same time distinctly positive influence of high dissolved oxygen concentrations on organic acid production was found in earlier studies conducted at RRL,Jammu. A coordinated study on the influence of oxygen partial pressure and dissolved oxygen concentrations in static and dynamic state on selected bacterial and fungal species was therefore planned.

(i) Studies on Aspergillus niger in airlift reactor

Due to simplicity of its operation and comparability of data created at two research centres the airlift fermenter was selected for all fermentation experiments.Based on the design of airlift reactor develpoed at TCB, Dortmund, a simple airlift fermenter was designed and fabricated at RRL,Jammu. The data obtained on growth of *Aspergillus niger* and organic acid production in this reactor revealed that the reactor type excels in reliability and low power requirement. As in the case of bubble columns, the desired morphology of *Aspergillus niger i.e.* pellet growth is obtained in laboratory airlift fermenter as well as in a pilot scale airlift reactor of 260 1 capacity. Thus pellet formation is achieved under rather low stress conditions as compared to stirred reactors where high agitation conditions are required to achieve similar results. A comparative data obtained in airlift and stirred tanks has been published as our first two joint publications (Ref: *J. Ferment. Bioeng* (Japan) **68**, 112-116 (1989) and **69**, 72-74 (1990).

(ii) Influence of oxygen on glucose oxidase in Aspergillus niger

Studies were conducted on the influence of oxygen partial pressure and comparable dissolved oxygen concentrations on glucose oxidase and

gluconic acid production by *Aspergillus niger*. The data from these studies revealed that the stimulatory effect of high oxygen concentrations result not only from an increase in enzyme kinetics according to Michaelis Menten, but also to a stimulated formation of both endo- and exocellular glucose oxidase. An organised export of glucose oxidase out of the cell envelope was observed. The two fractions of the enzyme (exo- and endo-cellular) showed different activities in their contribution to overall acid production (Ref. *J.Chem. Technol. Biotechnol.*, **50**, 1-11, (1991)).

(iii) Optimisation of design parameters — studies at pilot scale in airlift loop reactor

The influence of distributed parameters on growth and organic acid production with a view to optimise design of bioreactor for the process were studied. The studies were conducted in 9.2 m liquid height (200 l) airlift external loop reactor under controlled liquid circulation velocities and varied oxygen partial pressures. The dissolved oxygen gradients prevailing in the reactor at varied liquid circulations were examined and their influence on productivity studied and the data was used for scale down experiments.

A comparative study of the influences on *Aspergillus niger* and *Gluconobacter oxydans* was published (Ref.: *DECHEMA Biotechnology Conference 4* VCH Verlagsgesellschaft 729-732 (1990)).

(iv) Scale down studies — Influence of oscillating dissolved oxygen concentrations

Scale down experiments were conducted in a well mixed 10 L laboratory airlift fermenter. With the help of computer controlled devices, local variations of dissolved oxygen prevailing in large scale reactors were simulated. Dissolved oxygen was sinusoidally oscillated between 70 and 130% saturation with air at 1 bar, the period of the oscillating loop was varied to simulate three distinct circulation velocities of 90 s, 140 s, and 200 s. *Aspergillus niger* was subjected to these periodically changing oxygen conditions and its effect on endo- and exocellular glucose oxidase and overall production profiles was studied. Positive influence of oscillating dissolved oxygen on enzyme synthesis was found to compensate for the otherwise negative effect of low oxygen on the reaction kinetics. Based on above findings the following patents were filed in India and Germany:

Refs : *Deutsche Patentanmeldung* P 39 14 136.5-41 (1989) and

Indian Patent Application No.671/DEL/89 (28.07.1989).

Investigations on diketo acid producing *Gluconobacter oxydans*

(i) Studies on the influence of distributed parameters on Gluconobacter oxydans

In order to elucidate the dependence of organisms for the influence of distributed parameters of dissolved oxygen, the studies were conducted on *Gluconobacter oxydans* subsps. melanogenum. While the two distinct enzymes with different Michaelis-Menten kinetics are involved for direct glucose oxidation in *Aspergillus niger* and *Gluconobacter oxydans* both are influenced by oxygen. This was demonstrated through our studies on batch cultivation of *Gluconobacter oxydans* in an airlift reactor; production of ketogluconate as an important intermediate of Vitamin C biosynthesis was evaluated.

Ref.: *Biotechnol Lett.*, **12**(2), 111-117 (1990) and *Enzyme Microbiol. Technol.***13**, 504-507 (1991).

(ii) Oxygen influence on chemostat cultures of Gluconobacter oxydans

The threshold concentration of dissolved oxygen for the induction of a membrane bound dehydrogenase complex in *Gluconobacter oxydans* was determined in chemostat culture set up by us for the purpose. For *Gluconobacter oxydans* 30% saturation of oxygen related to air at 1 bar as critical oxygen concentration for enzyme induction as compared to over 100% for *Aspergillus niger* was found.

(iii) Influence of oscillating dissolved oxygen on Gluconobacter oxydans

Like in the case of *Aspergillus niger*, cultures of *Gluconobacter oxydans* were also subjected to oscillating dissolved oxygen within the threshold concentration range. The influence of residence time of culture at subcritical oxygen concentration on the synthesis of dehydrogenases was studied. Oscillations in dissolved oxygen were created such that the arithmetic mean value was the subcritical concentration *i.e.* > 30% air saturation at 1 bar. Simulating industrial loop reactors the residence time of the culture at suboptimal concentrations was varied from 80% to 20% of the total loop time. The results have revealed the critical time cycle for which the organism can withstand without major adverse influence on growth and product formation.

12 IH 01 Processing of Fur Skins

Effect of ^{60}Co-gamma radiation on the properties of furs

Earlier experiments on the effect of ^{60}Co-gamma radiation on various use properties of rabbit furs tanned with different vegetable tanning agents

and basic aluminium sulphate showed that major changes in bonding take place between radiation dose of 10.0 to 30.3 kGy. (Ref. *Radiat. Phy. Chem.*, **36**, 313 (1990).

Experiments were carried out to study the effect of ^{60}Co-gamma radiation on the binding properties in furs between collagen and finishing chemicals added during processing (mineral tanning agents and fats). Results of these experiments showed that alum tanning agent being a weaker tanning agent suffers detannage while chrome gets firmly bound during reorientation reactions as a result of ^{60}Co gamma radiation.

The moisture content of the radiated samples is found on the higher side, because more amino and acid groups are liberated in the matrix during reaction process.

The free fat content decreased with the increase in the radiation dose from 5 to 110 kGy of ^{60}Co-gamma rays. The overall feel of the radiated samples was harsher in comparison to the control samples because of detannage loss in free fats and increase in moisture content.

INFRASTRUCTURE

CHEMICAL ENGINEERING AND DESIGN

1. Turn-key projects

(a) Setting up of a multipurpose plant for the manufacture of natural dyes and pigments, for Government of Vietnam

(A UNIDO Project through NRDC, New Delhi)

As reported last year a multipurpose plant having a capacity to process 50 kg of raw material per batch was designed. The process development of extraction of natural dyes like bixin from *Bixa orellana* seeds, curcumin from *Curcuma longa* and leuco dye from *Diospyros mollis* was undertaken along with Natural Products Chemistry Division. The plant was fabricated in RRL Workshop and finally it has been successfully commissioned at Ho Chi Minh City-Vietnam by RRL Scientists and Engineers.

(b) Setting up a plant for aroma chemicals in Vietnam (through UNIDO, Vienna)

This Laboratory has been retained by United Nations Development Programme (UNDP) to design and fabricate a multi-purpose plant for the manufacture of various aroma chemicals and to instal the same in Vietnam. The plant has the capacity to process 100 kg crude oil per batch to obtain pure geraniol, citronellol and terpeniol etc. The plant has been fabricated in RRL Workshop. The plant will be despatched for installation in Vietnam in the month of June,1992.

2. Process Development

(a) Desalination of brackish water by thermally regenerable ion-exchanger

The aim and objective of the project is to obtain the pure potable water in arid zones at relatively cheaper costs. After studying the thermal properties of various types of weakly acidic and weakly basic resins, actual desalination of saline water of 1,000-5,000 ppm salinity was studied using the mixed beds

of weakly acidic and weakly basic resins. The resins employed were TULSION brand of M/s Thermax, and INDION of M/s Ion-Exchange India Ltd.

For sorption and regeneration steps, different pairs of resins in different ratios were studied to arrive at optimum pair and optimum resin ratio. Although sorption steps showed some promising results, the regeneration step was not upto expected level. Further experimentation is in progress.

Efforts are being made to procure amphoteric resins from outside India and use these instead of conventional mixed bed resins.

(b) Extraction of podophylotoxin

Extraction of podophylotoxin from *Podophyllum emodi* was optimized. A technical report for the process has been prepared.

(c) Preparation of p-methoxyphenylacetic acid

A two steps process starting from anisol is being developed for the preparation of *p*-methoxyphenylacetic acid. A yield of about 95% of *p*-methoxyacetophenone has been obtained in the first step. The yield in the 2nd step of *p*-methoxyphenylacetic acid is being established by repeated trials which is expected to be about 60%.

3. Sponsored project

Precipitation of calcium carbonate

This Laboratory was engaged by M/s A.S.Yadav of Bhopal to work on sponsored project of precipitated calcium carbonate. C & D Division and Mineral Division are jointly handling this project. A brief project report was supplied to the Party last year. This year lime stone from Ametha Mines, Katni(M.P.) was procured and is currently under examination to find its actual composition. A detailed project report covering process details, specifications of plant and equipment, manpower and utilities and project profile giving cost analysis was submitted to the party.

4. Design development

Centrifugal machine for the extraction of pomegranate seeds from the skin

A 375 mm dia model of the extractor was fabricated in the Workshop. It gave good results. A new model of 450 mm dia extractor with some modification is being fabricated for future trials.

5. Engineering consultancies

This Laboratory was engaged under Engineering Consultancy Programme by the following parties:

(i) M/s Super Rosin, Jammu.

Plant Capacity — to process 1500 litres of turpentine oil per batch to obtain terpeniol rich pine oil.

(ii) M/s Dujodwala Resins and Terpenes, Bari Brahmana,Jammu.

Plant Capacity — 2 tonnes per batch of disproportionated rosin.

6. Advisory consultancy

M/s Dewan Modern Breweries,Jammu was given the design of a fermenter and a storage tank of 25 m^3 capacity each under advisory consultancy.

7. Project report

A comprehensive project report for the manufacture of bolder crystals of menthol from *Mentha arvensis* oil was prepared giving process details, design drawings of the equipment, specifications of standard machinery for a plant capacity of 10 kg bolder crystals per day.

8. Training imparted

Mr. Nguyen Quang Hein, a Chemical Engineer from Vietnam was given training on the design of packed type batch fractionating column, for 2 months (Feb-March,1992).

WORKSHOP

1. Turn-Key Projects

(a) Plant for aroma chemicals

Workshop has prepared the design drawings for plant equipment and procured the entire material for fabrication. The fabrication work started in October,1991, has been completed. The main equipments fabricated are S.S.Fractionating Column, S.S.Reboiler, S.S.Condensers, S.S.Receivers, Hot Oil Circulation System, S.S.Storage tank, S.S.Vapour trap, M.S.Structures for installation of main equipment. The plant is expected to be installed in Vietnam by April 1993.

(b) Natural Dyes and Pigments Plant

This plant which was fabricated in Workshop from March,1991 to July, 1991, was despatched to Vietnam in November, 1991. Our engineer alongwith technicians were deputed to Vietnam for erection and installation of this Plant in March, 1992 and completed the job in April, 1992.

2. Repair and maintenance jobs

The workshop completed repair and maintenance jobs as under:

Mechanical	=	456 nos.
Electricals	=	915 nos.
Refrigeration	=	78 nos.

INSTRUMENTATION

(a) Analytical data service

The samples analysed during the year with the sophisticated analytical instruments are detailed below:

Instrument	No. of samples
Ultraviolet / visible spectrophotometer	
(i) Optical density	17,783
(ii) Spectra taken	790
Infra Red Spectrophotometer	140
Dichrograph (CD/ORD)	73
Spectrometers	
FT-NMR FX 90Q	1,422
NMR T-60A Varian	567
High Pressure Liquid Chromatograph (H.P.L.C)	1,323
Gas Chromatograph (GLC)	1,561

(b) Repair / Maintenance of Instruments

The repair/maintenance of sophisticated analytical instruments installed in Instrumentation Section as well as electrical and electronic instruments (like spectrophotometers, spectrometers, HPLC,GC,DCCC,Beta-counter, DNA transilluminator, Liquid Scintillation Counter, computers, fermenters, centrifuges, growth chambers, incubators, balances, stabilisers etc) installed in other sections was done by the staff of this Section.

(c) Analytical facility added

NMR-JNM-Pmx60 Jeol for the H^1 spectral analysis

GC-Mass QP 2000 - Shimadzu

Dura dry-freeze drier for drying the plant extracts to a fine amorphous powder.

(d) Other activities

(i) Computer services

Computer Centre services are provided to the scientists for graphical/ tabulations/documentations required for publication of scientific papers). Computer facility is also provided for various other activities such as Research Council proceedings/Annual reports, Pay bills, Flower show and Seminars etc.

(ii) Sample analysis facility

The testing facility was provided to Hindustan Lever Pvt. Ltd. Jammu and C.D.R.I., Lucknow.

(iii) Training

Engineering students from various universities were trained in Computer Programming / Operation , electronics Instrumentations etc.

TECHNICAL CELL AND LIBRARY

(a) Publications

RRL,Jammu Annual Report 1990-91.

RRL Newsletter, Vol. 18 (1991), Issue 2-4 - Pages 12
Vol. 19 (1992), Issue 1 - Pages 4

Technical folders

Cultivation of Hops

Cultivation of Lemongrass

Cultivation of Jamrosa

(b) Publicity, sale and distribution of publications

(i) Books

Cultivation & Utilization of Medicinal Plants

Cultivation & Utilization of Aromatic Plants

Indian Mushroom Science-II

Chemistry and Pharmacology of Vasicine: A new Oxytocic and Abortifacient.

RRL Jammu Silver Jubilee Commemorative Lectures

(ii) Monographs

Himalayan *Heracleum* Linn.(Hogweed) - A Review

Ergot Production in India

Cultivation of Asparagus

(iii) Survey reports

Essential Oil and Perfumery Industry in North India

Rose and Rose Oil Industry in India

(iv) Technical folders

Cultivation of Hops

Cultivation of Lemongrass

Cultivation of Jamrosa

(v) Periodicals

RRL Newsletter } Current and back issues.
Annual Report }

(c) Other technical activities

(i) Write-ups related to RRL activities for publication in CSIR News and other publications/directories

(ii) Printing jobs of technical nature in respect of International Symposium like Souvenir, Abstracts etc.

(iii) Printing jobs of technical nature in respect of other activities like Foundation Days (CSIR & RRL,Jammu) Training Programmes, Flower Show etc.

(iv) Technical enquiries related to R&D activities of the Laboratory

(d) Library

(i) Collection development

Additions during the period and total holdings as on 31.3.1992 are given below:

Type of Document	Additions	Total Collection
Books	129	15119
Bound Journals	867	18580
Standard specification	3	1424
Photocopies & translations	33	1639
Annual reports	28	1279
Pamphlets	7	598
Maps and atlases	—	140
Technical films	—	11
Microfiche	—	25

(ii) 258 journals were received both at Jammu and Srinagar out of which 192 were subscribed and remaining received gratis/exchange. New Subscriptions taken out are as under:

Immunology Today, Cambridge (England)
Parasitology Today,Cambridge

(iii) 268 reprints of papers published by staff were distributed to various scientific workers on request.

(iv) Services

Besides S&T staff of Jammu, Srinagar and Palampur, the Library continued to extend reference and consultation facilities to persons from industries, government departments, research scholars from local university and colleges. During the period 985 external users consulted the Library resources.

PUBLICATIONS

A. Books

Kapur, S.K. and Shahi,A.K. - *Grasses of North West India*, (M/s Merry Land Prakashan, Bikaner),1991, pp.106 + plates 11.

B. Monograph

Pandita, P.N. - Asparagus Cultivation

C. Technical folders

Cultivation of Hops
Cultivation of Lemongrass
Cultivation of Jamrosa

D. Reviews

Kak,S.N. - Toxic plants - an overview, in book - *"Higher Plants of Indian Subcontient"* (M/s Bishen Singh Mahender Pal Singh, DehraDun), **Vol. II**, 1991,241-48.

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E. Reports

Pandita,P.N. - Domestication and cultivation of *Angelica archangelica* L. (Submitted to J&K State Council for Science and Technology).

F. Papers

Abraham,S.P. - Kashmir agarics : an overview; in book - *Indian Mushrooms (Proceedings of the National Symposium on Mushrooms)*, M.C. Nair (Ed.) (Kerala Agricultural University and Mycological Society of India) Trivandrum 1991, 13-24.

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Bhutani,K.K. and Thakur,R.N. - The microbiological transformation of parthenin by *Beauveria bassiana* and *Sporotrichum pulverulentum; Phytochem.,***30**, 1991, 3599-3600.

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Chowdhary, S K and Mukesh Mohan - Sericulture holistic approach for women development in Himalayan region

Raina R K - Rabbit breeding for socio-economic upliftment of rural women in Himalayas.

Czechoslovak Academy of Sciences : International Conference on *"Regulation of Insect Reproduction"* held at Zinkovy (Czechslovakia) from September 23-28, 1991.

Chowdhary,S K., Jain, S M., Goyal,R.,Sharma, S D. and Ogra, R K - Studies on the effect of phytoecdysones (MH) analogues for increasing fecundity in Tasar silkworm *Anthereae proylei.* J.

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Bakshi,S.K.,Jotshi,P.N. and Kitchlu,S. - Breeding of new aroma hop variety in Kashmir.

Balyan,S S., Choudhary, D.K. and Kaul,B.L. - Response of celery *(Apium graveolens* L.) strain "RRL-85'-1" to time and method of sowing.

Bradu,B L., Sarin, Y.K. and Gupta, S.C . - Kashmir *Matricaria* rich in alpha-bisabalol and its oxides.

Bradu,B.L. - Clocimum-3c: a potential source of clove oil type Its ample prospectus of development in south India.

Chandra,S., Sobti, S.N. and Singh, A. - Harvest management practices of Jamrosa grass (RRL-82).

Chopra,C.L. and Somal, P - Scope of biotransformations in essentail oils.

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Grewal S., Ahuja A., Koul, S. and Sambyal,M - Application of tissue culture technique to some essential oil bearing plants:

Gupta, S.C.,Sobti,S.N. and Sarin, Y.K. - Development of a linalool rich strain of*Ocimum canum* Sims.

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Kak,S.N., Pal, S. and Kaul,B.L. - Comparative performance of improved strains of Japanese mint.

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Pal,S., Chandra,S. and Balayan,S.S. - Nitrogen requirement of new lemongrass strain CKP-25.

Rao, B.L., Sobti, S.N., Sarin, Y.K and Kaul, B.L. -CKP-25 an additional source for citral.

Sarin,Y.K., Dhar,K.L., Thappa,R.K., Agarwal, S.G. and Kapahi, B.K.- Aromatic flora of the Himalayan region.Prospects of commercial utilization.

Shahi,A.K. - *Cymbopogon jwarancusa* (Jones) Schult. Sub- species Olivieri (Boiss) Soenarko-A wild aromatic grass of Indian Thar desert as an additional source of citral.

Thappa,R.K.,Agarwal,S.G.,Kalia,N.K. and Kapoor,R. -Chemical composition of various stages of flowering and fruiting.

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Chemists and Technologists Association of Carbohydrates and FRI, Dehra Dun: Conference held at DehraDun from November 10-11,1991.

Chawla, J.S. -Utilization of lignocellulosic materials.

American Chemical Society, Cellulose Paper and Textile Division, U.S.A.: *Cellulose-91,* Conference held at New Orleans (USA) from December 2-6,1991.

Chawla,J.S. - Composite and hybrid composite boards from lignocellulose- future needs.

Society of Biological Chemists (India): 60th Annual Meeting held at Calcutta from December 27-30,1991.

Gupta, A.K., Bhatia,A.K. and Kumar, N. - Chemical constituents of traditionally processed Sikkimese tea.

Khajuria,A., Johri,R.K. and Zutshi,U. - Status of glutathione metabolism and lipid peroxidation in mucosa and epithelial cells of rat intestine- Effect of piperine.

Kumar, N., Bhatia,A.K., Bhasin,A.K. and Singh,H. - Chemical composition of some wild edible plants of Sikkim region.

Karnataka Ayurvedic and Unani Practioners Board : Symposium on *"4th World Congress Holistic Approach Health for All,"* held at Bangalore from December 28-31, 1991.

Kaul, M.K. Characteristics of ethnopharmacological resources in west Himalayas.

Sharma,P.K.-Traditional medicine used as antidotes for snake and scorpion bites in north India.

Essential Oil Association of India, Madurai District Small Industries Service Institute and Tamil Nadu Agricultural University : Regional Seminar on. *"Development of Essential Oil Industries"*, held at Kodaikanal from March 5-7, 1992.

Bradu, B.L. - Clocimum-3c : a potent source of clove oil type Its ample prospectus of development in south India.

Gupta,S.C. and Sobti, S.N. - Effect of time of harvest on yield and chemical composition of essential oils in *Ocimum sps.*

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Pal,S., Chandra,S., Balyan,S.S., Prabhu Dutt and Rao, B.L. (Mrs)- Effect of different spacing on fresh herbage and oil yield on CKP-25.

Rao, B.L. and Lala, Sunita -Optimisation of the oil yield in CKP- 25.

Indian Association for Cancer Research and Amala Cancer Research Centre, Trichur : 11th Annual Convention and National Symposium on *"Biolcgy of Cancer" (Modern Concepts and Recent Developments)*, held at Trichur from March 13-15,1992.

George,V., Shah,Rita and Kapil, Aruna - Fractionation and anti- complementary activities of plysaccharide from mushroom *Russula foetens.*

Invited Lectures by Dr.R.S.Kapil

Abroad

(i) *University of Peradeniya (Sri Lanka)*

22.5.1991 Biosynthesis of natural product-Current Indian sub continent scene.

(ii) *University of Philippines,(Philippines)*

4.2.1992 - Indian traditional plants - a new strategy for search of bioactive materials.

India

(i) *Andhra University, Visakhapatnam*

18.6.1991 - Indian medicinal plants - a new strategy for search of bioactive materials

(ii) *University of Jammu*

18.1.1992 - Indian Traditional Plants - a new strategy for search of bioactive materials

(iii) *Central Drug Research Institute, Lucknow*

31.3.1992 - Current strategies on the development of new drugs from natural sources

PROCESSES DEVELOPED PROCESSES RELEASED CONSULTANCY

A. Patents

Author	*Title*
Satti, N.K. Suri, K.A. Suri, O.P. Kapil,Aruna Kapil,R.S. (No.NF/176/91)	A process for the isolation of polysaccharide fraction from *Picrorhiza kurroa* possessing immunostimulatory activity.
Ravi,S.Y. Kundu,B. Mathur,K.B. Puri,A. Saxena,R.P. Kapil, Aruna Saxena,K.C. (No.1043/DEL/91)	A process for the synthesis of glycopeptide N-acetyl-normuramyl-L-methylallyl-D isoglutamine and corresponding N-substituted amides possessing high immunostimulant activity

B. Consultancy

1) Technical know-how on agro-technology on hops in new areas	M/S Dewan Modern Breweries Ltd., Jammu.
Setting up of multipurpose fruits and vegetable processing industry.	Shri Bhawak Prashar Narain Lodge,VPO,Ambota (Dist.Una). M/S G.D.Industries, Bhopal.
Manufacture of medium density fibre boards.	M/S Nu Chem Agro Products, Tohana.
Manufacture of 3,4,5-trimethoxy-benzoic acid	i) M/S Numex Chemicals Pvt.Ltd.,Pathankot. ii) M/S Alpha Drugs India Ltd. Chandigarh. iii) M/s Finorg Chemicals Ltd. Chandigarh.

IMPORTANT LABORATORY ACTIVITIES

1. Major Events

A. Scientific

Symposium : An International Symposium on "Newer Trends on Essential Oils and Flavours" was organised by RRL,Jammu from October 21-23, 1991. It was sponsored by Essential Oil Association of India and Perfumes and Flavours Association of India.

B. Others

National Unity Week

National Unity Week was celebrated from November 19-25, 1991 at RRL,Jammu. The main activities organised during the week consisted of:

(i) National Integration Pledge on November 19,1991.

(ii) A Fraternal Procession (Prabhat Pheri) on November 24,1991.

(iii) Conservation Day on November 25,1991 which was observed as cleansing day for our Laboratory.

2. CSIR Foundation Day

RRL,Jammu celebrated CSIR Foundation Day on 26th September, 1991. It also coincides with the Golden Jubilee Celebrations of CSIR. The important activities as a part of this celebration were:

(a) Open Day - Entrepreneurs, students of local schools and colleges and citizens of Jammu visited this Laboratory and acquainted themselves with R&D activities Besides these it was marked with two meet:

(i) Students meet scientists

(ii) Entrepreneurs meet scientists.

(b) Foundation Day Function

In this function following major activities took place:

(i) Prizes to winners of essay competition (17 children got awards).

(ii) Prizes to winners of Science Quiz.(Five scientists got awards).

(iii) *Mementos*

10 Scientists who superannuated between September 1990 to August 1991 were presented quartz wall clocks.

(c) Celebration of Foundation Day

RRL, Jammu celebrated its Foundation Day on December 1,1991. The main highlights of the fucntion were:

(i) Presentation of Mementos to those ten staff members who had completed 30 years of service

(ii) Foundation Day lecture by Chief Guest Dr Nitya Anand on "Integrated approach for the development of drugs from plants"

(iii) Release of improved variety of lemongrass CKP-25

(iv) Release of booklet and of planting material

3. Training and Demonstration

(a) On Hops

A training course on cultivation and Post-harvest Processing of Hops was organised in collaboration with Department of Horticulture for one week in August 1991 at Keylong.

(b)On Rabbit Farming

A training course on Angora Rabbit Farming was organised at Panchmari from 11 to 15 November,1991 in collaboration with Polytechnology Transfer Centre, Bhopal.

(c) On Water Quality

It was organised from 20-27 May,1991 jointly with Industrial Toxicological Research Centre, Lucknow under " National Mission Project on Drinking Water". It was attended by 15 engineers of J&K Public Health Engineering Department.

(d) On Mushroom Cultivation and Processing

It was organised at Village Sarora, Jammu from 3-5 January,1992 in collaboration with Jammu and Kashmir State Council for Science and Technology. Fifty-five trainees (including 2 women) underwent this training

(e) On Improved Chalk-making

It was sponsored by Ministry of Human Resources Development under Literacy Programme and organised from 3 to 10 December, 1991 The

training was imparted through lectures, video-films, discussions and demonstrations.

(f) On Aquaculture

A training programme on Commercial Aquaculture was organised at village Budhi District Kathua from 23-25 March,1992 in collaboration with the Department of Science and Technology (J&K Government) under Rural Development programme. It was attended by 50 participants from different blocks. The training consisted of induced breeding, large scale seed production, nursery, pond management and feeding management, control of diseases, water analysis and net weaving techniques required in fish farming.

4. Participation in Exhibition

Our Laboratory participated in the Exhibition organised by the Central Social Welfare Board, New Delhi at India Gate from February 4-10,1992. Modern technology for cocoon and silk production was demonstrated from mulberry leaf to silk production. RRL stall bagged first prize which was presented by Mrs. Alva, Deputy Minister, Science and Technology (Government of India).

HONOURS AND AWARDS

(a) Awards to young Scientists

Shri Ravi Kant Khajuria and Dr P K Sharma have been awarded Young Scientist Award for the year 1991 in Chemistry and Botany respectively. These awards instituted this year by J&K State Council of Science and Technology consist of a citation and five thousand rupees in cash.

(b) Nominations/Membership

Dr.R.S.Kapil has been nominated as Member of the following:

(i) Sub-committee, Indian Pharmacopoea (Revised New Edition).

(ii) Editorial Board, Indian Journal of Chemistry, Section B, New Delhi (1992-94).

(iii) Editorial Board, Medicinal and Aromatic Plants Abstracts (MAPA), New Delhi (1992-94).

(iv) Editorial Board, Indian Drugs, Bombay (Since 1990).

(v) Board of Research Studies in Science, University of Jammu (1990-93).

(vi) Syndicate, University of Jammu (1990-93).

(vii) Advisory Board,Journal of Chemical Sciences (Guru Nanak Dev University), Amritsar (since 1990).

(viii) J&K State Council for Science and Technology, Srinagar /Jammu.

(ix) National Advisory Committee for setting up a new Department of Applied Chemistry in Guru Nanak Dev University, Amritsar.

(x) Research Advisory Committee,Regional Sericultural Research Station, Majra, DehraDun and Central Sericulture Research and Training Institute, Pampore (Central Silk Board)

(xi) Member of the Council National Organic Symposium Trust (1991-1996).

He also has been nominated for the following as:

(xii) *Expert* Central Crisis Group, Ministry of Environment and Forests (1991).

(xiii) *Advisor Patron*, Bharat Jyoti Perfumers and Growers Development Foundation, Lucknow.

(xiv) *Secretary*, Indian Medicinal Chemist Association.

Dr.Y.K.Sarin, Scientist-F has been nominated as a non-official member of Eigth Governing Body of the Central Council for Research in Ayurveda and Sidha for a period of 3 years (from 13 February, 1991).

Shri A.K.Bhatia has been nominated as a Member of State Level Science and Technology Committee for Entrepreneurship Development. He also has been nominated as a Member of Advisory Panel for Walnut, Directorate of Marketing and Inspection, Ministry of Agriculture (Government of India).

Dr.R.N.Thakur has been elected as a Councillor of the North Zone for the Indian Society of Plant Pathologists, Ludhiana, for the year 1992.

Dr.B.L.Bradu, has been elected as one of the Members of Executive Council of Essential Oil Association of India for 1991-1993 term.

Session Chaired

Dr.R.S.Kapil, Director,RRL,Jammu chaired the session in IUPA CNOST International Symposium on "Enzymes in Organic Synthesis" held at New Delhi from January 6-9,1992.

Recognition as a Guide

Dr.S.N.Kak has been recognised as guide to supervise Ph.D. scholars of University of Jammu.

Dr.D.K.Choudhary has been recognised as guide to supervise Ph.D.scholars of the University of Jammu.

(c) Award of Ph.D Degree

Bradu,B.L. - Genetical studies of various yield characters of Clocimum *(Ocimum gratissimum* Linn.) in relation to eugenol and other chemical constituents, University of Jammu; Supervisor-Dr.S.N.Sobti, Scientist-F (Rtd.),RRL,Jammu.

Gupta, S. - Study of genetical basis of chemical constituents of essential oil in Basilicum group of genus *Ocimum*; University of Jammu; Supervisor - Dr.S.N.Sobti, Scientist F (retd.) ,RRL,Jammu.

Shahi, A.K. - Ecological studies on some desert grasses with special reference to *Cymbopogon jwarancusa* (Jones) Schult; University of Jodhpur; Supervisor - Prof.D.N.Sen, Botany Department, University of Jodhpur.

Sharma, M.L. - Evaluation of immunomodulatory activity of some medicinal plants in mammals; University of Jammu; Supervisors, Dr.C.L.Chopra,Scientist-G,RRL,Jammu and Prof.P.L.Duda, Professor,Department of Biosciences,Univesity of Jammu.

Sharma,A.K. Biological control agents for insect vectors molecular and physiological studies of mosquito larvicidal bacterium *Bacillus thuringiensis* sub.sp. israelensis strain 4Q6. Anna University of Madras. Supervisor- Prof.(Mrs.) Kunthla Jayraman,Director,Centre for Biotechnology, University of Madras.

Sharma,S.C. Chemical Investigations of the metabolites of some drugs. University of Jammu; Supervisors- Dr. K. L. Dhar, Scientist F and Dr. C. K. Atal, ex-Director, R.R.L, Jammu.

Singh,Virender- Ethnobotanical studies in Gurez, Karnah and Lolab Valleys of Kashmir Himalaya; University of Garhwal; Supervisors- Dr.M.K.Kaul, Scientist, RRL,Jammu and Dr.R.D.Gaur, Department of Botany, Garhwal University.

VISIT ABROAD

Dr. R.S.Kapil,Director visited Sri Lanka from 20-23 May 1991 to attend symposium on "Natural Products Chemistry" in the University of Paredeniya. He also visited Philippines from February 2-12, 1992 under INSA-NAST, Philippines Exchange of Scientists Programme to attend 7th Asian Symposium on "Medicinal Plants, Spices and other Natural Products" held at Manila.

Shri C.L.Tikoo, Chairman, Chemical Engineering and Design Division visited Vietnam for six months (November 1991 to April,1992) as UNIDO Expert for the installation and commissioning of Natural and Synthetic Dyes Plant and to complete the pre-installation activities for Aroma Chemicals Plant for which RRL,Jammu is the sub-contractor.

Dr.G.B.Singh, Scientist EI visited Germany under CSIR-KFA Programme from 7 March to 15 March,1992. He delivered a lecture on "Pharmacological profile of boswellic acids from *Boswellia serrata*, a new class of anti inflammatory drug".

Dr.O.P.Gupta, Scientist EI, visited Poland from 15 September to 15 November, 1991 under INSA-PAS Scientist Exchange Programme. He also delivered a lecture on "Need and importance of development of new testing models".

Dr.S.K.Chowdhary,Scientist E1, visited Czechoslovakia from 16 September to 15 November, 1991 under CSIR-CSAV Scientific Collaborative Programme. He attended a sympsoium on "Regulation of Insect Reproduction" and acquired knowledge on cell culture of silk gland.

Dr.P.N.Pandita,Scientist C, visited Czechoslovakia from 15 September to 14 October, 1991 under CSIR-CSAV Exchange Programme. He visited various laboratories and acquainted himself with R&D activities in the field of Botany (including Medicinal and Aromatic Plants".

Dr.R.K.Johri,Scientist C, visited France from 1 October to 25 November,1991 under CSIR-CNRS Exchange Programme. He visited various laboratories and acquired knowledge on bioavailability enhancing action of Cyclodextrin group of molecule.

Dr.(Mrs.) Sushma Koul, Scientist C, visited FRG from 1 April to 28 June,1991 under INSA-DFG Exchange Programme. She worked with Prof. E.Reinhard, Dept. of Pharmaceutical Sciences, University of Tubingen.

SALE/DISTRIBUTION OF PROPAGATING MATERIALS

Salix spp. cuttings	54,000	nos.
Telosma pallida seedlings	430	-do-
Hops cuttings	700	-do-
Asparagus seed	6	kg.
Mentha suckers	800	kg.
Lemongrass slips	1,69,500	Nos.
Fish seed	65,850	Nos.
Mushroom spawn	306	bottles

SALE OF RESEARCH PRODUCE

Dried *Ecalyptus* leaves	60.1	Q
Silk cloth	185	m
File covers	5000	nos.
Fish	515	kg
Rats(Laboratory white)	664	nos.
Essential Oils of		
Lemongrass	667.25	kg
Jamrosa	45.6	kg
Java citronella	1.0	kg
Mentha arvensis	30.0	kg
Palmarosa	28.0	kg
Others	50.0	kg
(RRL-57 and 59 and 14)		

SERVICE RENDERED TO PRIVATE PARTIES

(a)	Testing for total coumarins	2 samples
(b)	Testing of water for its quality and suitability for human consumption	300 samples
(c)	*Testing for quality control:*	
	(i) Limestone	50 samples
	(ii) Zinc metal alloy	20 samples
	(iii) Alum	10 samples
	(iv) Gypsum urea adduct (in-house project)for nitrogen content	20 samples

STAFF
As on 31.3.1992

DR.R.S.KAPIL
DIRECTOR

SCIENTIST G

DR. C.L.CHOPRA

SCIENTIST F

DR. S.K.MEHTA
DR. J.S.CHAWLA
DR. Y.K.SARIN
DR. K.L.DHAR

SCIENTIST EII

PROF. K.K.KAPUR
SH. A.K.BHATIA
DR. B.L.KAUL
DR. S.K.BANERJEE
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